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BRIEFLY TOLD.

THE AUGUST MEETING OF THE SOCIETY OF GAS LIGHTING.—Col. Fred. S. Benson, Secretary of the Society of Gas Lighting, has notified the members that the August meeting of the Society will be held at Squantum, on Wednesday, the 12th inst. The members, of course, will note that the time named is a day in advance of the regular order of meeting, which, as specified in the Society's rules, is set for the second Thursday of each month. Those from this section who propose to take part in the August outing will leave for Squantum, by boat sailing from New Pier, No. 36, North river, at 5:30 P.M., of August 11th. Pier 36 (new) is one block north of Canal street.

ANOTHER PROPOSED "STRIKE" IN MONTREAL.—It was fairly presumable that, with the agreement reached some months ago between the local authorities of Montreal and the proprietors of the Montreal Gas Company, respecting the terms under which the former would accept and the latter would maintain a gas supply in the named city, not much more would be recorded in the immediate present, or, for that matter, in the far future, in the instance of attempts to interfere with the Montreal Gas Company in the performance of the duties which had been put upon it and in the completing of the contract which it assumed. The covetous, however, are ever on the watch, and the agreement between the city and the Montreal Company, which was only arrived at after months of consideration, study and contention, was hardly completed before a hardy speculator appears with a plea that he, through the active participation and complete financial support of the city authorities, shall be permitted to build a gas works, on city account, virtually for whatever profit can be extracted from the construction by himself and associates. The plea in full will be found in our current item columns; and for unsurpassed cheekiness, bearing in mind the agreement which now exists over the gas supply of Montreal between the authorities and the Montreal Company, it must command admiration. Cheekiness, however, is not everything; wherefore we imagine "Contractor" King's astonishing proposal will suffer a speedy and deep burial.

MR. M. N. FORNEY STILL IN THE FIELD.—Although Mr. Forney has retired from active journalism, through the comparatively recent sale of his interests in the *American Engineer and Railroad Journal* to other parties, that urbane and accomplished gentleman and engineer proposes to remain actively in business. In a circular letter issued by him this month he recites accurately just what he proposes to do: "Having opened an office in the Taylor Building, No. 41 Cortlandt street, New York," he says, "I am now prepared to furnish designs, drawings and specifications of locomotives, cars and other railroad machinery and appliances, steam engines, boilers, plans of shops, their equipment, etc." The circular also conveys the intimation that he will act in a general way to represent the interests of clients who are disposed to consult him in matters relating to railroad engineering. Mr. Frank J. French will act as Mr. Forney's business manager.

NOTES.—Accountant McCarthy, who was instructed to examine the condition of the affairs of the "Light Department" of Richmond, Va.,

reported that as far as he could ascertain, after careful investigation, the public gas works, in the financial aspect thereof, were being "carefully and faithfully administered," and that the "energy and vigilance of the Superintendent are everywhere apparent."——The residents of Santa Clara (Cal.) are considering the matter of establishing a gas works at that point.——At the annual meeting of the Northampton (Mass.) Gas Company the report of the Superintendent showed that the increase in sendout for the year was well over 10 per cent. in advance of the corresponding twelvemonth. The election resulted as follows: Directors: John F. Starr, L. C. Seelye, Geo. P. Dickinson, D. W. Crafts and C. N. Clark; President, C. N. Clark; Secretary and Treasurer, Geo. P. Dickinson; Superintendent, D. W. Crafts.——A correspondent, under date of July 31st, forwards the following: "Yesterday the city of Des Moines, Iowa, received $735.75 from the Capital City Gas Light Company, which sum represents 2 per cent. of the gross receipts of the Company for five months. The payment is in line of the requirement of the new ordinance gas rates. The ordinance provided that the city should be entitled to 2 per cent. of the gross receipts of the Company, which should be payable half-yearly. The new rates took effect on the 1st of January, 1896, and yesterday furnished the first result of the ordinance. According to the ordinance the city was not entitled to a share of the receipts for January—that is, the payments for gas consumed during December, so the money received yesterday is 2 per cent. of the gross receipts from January to May, inclusive. The next payment to be made will be for the months of June to December, inclusive. The total receipts of the Company for the five months were $36,787.50, and for the present year the total would be $88,266, at this rate. Manager Pratt, of the Gas Company, in speaking of the effect of the new ordinance upon the city and the Company, said: 'Our payment to day was according to the new ordinance. As will be seen, it indicates that the consumption of gas has increased about 13 or 14 per cent. under the new rates. However, I do not attribute the increase to the new rates, although that was a feature. I think that energetic action on the part of the Gas Company has been the direct cause. Our employees have been instructed to work with might and main in arguing for a larger consumption of gas. We have offered every inducement to people to use gas. To be sure, cheapness is a factor. Oftentimes we have found a man who has purchased a gasoline stove, putting $28 or $30 into it. In such cases we allow a reasonable value for the gasoline stove, and replaced it with a gas stove. We have urged that a gas stove means a free service pipe, and have suggested other ideas in the same line to cause the person not only to use gas as a cooking agent but as an illuminating medium as well. I believe that the reduction in rates will be a great factor in the future in increasing consumption of gas—just as soon as the people learn that gas at the present cost is cheaper than other cooking or illuminating agents. Referring to those who were consumers under the old prices, the new rates have made little or no difference in their consumption. In fact, I believe that people will use as much gas as they need, and that the rate is not material so far as their use of gas is concerned. The Company is beginning to extensively improve its properties. It has been three years since we laid any mains, the long controversy with the city over the readjustment of gas rates having kept the betterments in abeyance. We contemplate laying from 12 to 14 miles of mains this summer, and have already laid 8 or 9. We have done for labor more than any other of the large Des Moines corporations have, keeping about 125 men on our street work this summer. A coal storage shed with a capacity of 3,000 tons will be one of our improvements. I regard 8 or 10 per cent. as a good return on an investment in a manufacturing concern, and previous to the new rates going into effect we could earn 8 per cent. One can easily see, however, that the lower gas charges will cause a decrease in our earning power, and I anticipate that our return this year will not be in excess of 6 per cent. Of course, improvements will be a large factor in reducing our return, but at the same time the betterments will go towards increasing the value of our plant. Merchants and manufacturers generally would not consider 8 per cent. a very good return, but with us, a public corporation, it is different. People at large do not understand the great cost of keeping up and improving corporate interests, and they believe that, because their is a great volume of business, there must of necessity be large profits. To be sure, business men will recognize this fallacy, for they know what it costs to run a huge establishment, if the workmen employed are to be paid better than a living wage.'"——The Sioux City (Iowa) Gas Light Company has applied to Councils for a renewal of its franchise for a period of 25 years, from and after the expiration of its present leasehold or grant, which terminates February 26, 1897.——The Hornellsville (N.Y.) Company has been granted the permission necessary for its proposed main extensions.

[Translated from the French, by Mr. Herman Poole.]

The Action of Illuminating Gas on Rubber Tubing.

By Mr. H. Grosheintz, in the Bulletin of the Industrial Society of Mulhouse.

I have been induced to make some experiments on this subject, by the following system. To observe the variations of pressure of illuminating gas, I attached a gas jet, by means of an indiarubber tube, to a water manometer, formed of a glass tube, made U-shaped, and filled with a colored liquid serving as an index. The reading of the pressure being made and the gas shut off, I was astonished to see, after a dozen hours, that the pressure in the manometer was replaced by a depression of the liquid. This phenomenon was produced at each verification made with the manometer. Before attributing it to an effect of endosmosis, I examined our gas to ascertain if it contained substances soluble in water, or capable of uniting in the vessel containing the colored liquid; but it was not so. Nothing then remained but to attribute the phenomenon to the caoutchouc of the tubing itself.

To verify this assertion I bent, in shape of a siphon, some glass tubes one-fifth inch diameter and about 42 inches long. The long arm of the siphon was immersed in a vessel of water so much that the other had a length of only 4 inches. To this short arm was attached the rubber tube to be tested.

A series of six similar glass tubes was placed in a battery on a vessel of water, each tube being furnished with a caoutchouc tube 19.7 inches long, but of different diameters and composition.

No. of Series.	Material of Tube Tested.	Interior Diameter. Inch.	Exterior Diameter. Inch.	Thickness of Wall. Inch.	Volume of Caoutchouc. Cubic Inch.
1	Black rubber..	0.139	0.238	0.049	0.61
2	" ..	0.197	0.394	0.098	1.83
3	Common gray.	0.354	0.553	0.100	2.81
4	Common red..	0.354	0.553	0.100	2.81
5	Heavy red	0.315	0.669	0.177	5.31
6	Heavy black..	0.315	0.630	0.157	4.58

To fill these tubes with illuminating gas, the gas was passed in by the caoutchouc tube and allowed to stand over the water for 10 minutes, so as to almost entirely expel the air; in every case the same method of operation was used with each of the six tubes. Hence we may suppose they were subjected to the same conditions.

To close them the same method was used, with the finger partly immersed in the water, while another person put into the rubber tube the end of a glass rod well greased.

The experiments thus conducted gave the following results at the end of the 20th day:

No. of Experiment.	Depression* at End of 20 Days. Inches.	Maximum Depression was of Inches.	Maximum Depression was At End of Days.	Per Cent. of Gas Disappeared at End of 20th Day.
1..... ...	2.977	2.977	20	56.0
2.....	5.206	5.245	24	47,7
3.....	3.858	6 476	96	32,0
4.....	5.905	6.144	31	50,0
5.....	5.206	6.066	52	47.7
6.....	3.977	7.128	52†	34.6

* I call depression the distance of the liquid in the long arm below the level of the water in the vessel.

† The experiment with tube No. 6 had to be stopped as the liquid in the tube had passed the bend of the siphon and entered into the caoutchouc tube.

So that, based on the results of the measured depressions on the 20th day, the caoutchouc tubes used may be arranged as follows, the most permeable first—1, 4, 2, 5, 6, 3; 5 and 2 being equally so.

The depressions having attained their maximum after a very variable length of time, I carried on the experiments for two years to ascertain what would happen; as, for example, if an entrance of air would occur, and, in this case, at the end of how much time the depression approached 0. Here is the table:

Number of Series.	Maximum Depression. Inches.	Depression at End of Experiment. Inches.	Difference in Inches.	This Lower- Effected in Days.*	One-tenth Inch, in Days.
1.....	2.977	2.283	.694	605	87.2
2.	5.245	.315	4.930	541	10.9
3.....	6.476	4.764	1.712	477	27.9
4.....	6.144	.834	5.310	540	10.2
5.....	6.066	2.010	4.056	512	12.6

* This difference between the number of days when the depression approached 0 will be inferred from that of the maximum of depression requiring such unequal times to produce a like depression (see Table 2,) and as the experiment was stopped only as the maximum was reached.

From this view of the sequence of depression we may deduce the following order:

4, 2, 5, 3, 1.

My experiments were terminated and collated when the new bibliographic researches on this subject led me to a paper by Mr. K. Zulkowsky, in the *Berichte der Deutschen Chemiker Gesellschaft*, 1872, p. 759, and entitled, "Influence of Caoutchouc Tubes on the Illuminating Power of Gas Passing through Them." The author experimented in a different way from mine, and concluded that there was an absorption of gas by the caoutchouc. He determined that the rubber increased in weight by its contact with the gas, and on submitting the tubing to the action of a vacuum it gave up a certain portion of the gas so absorbed.

During the research I have repeated some of the experiments to control results obtained. I give an instance of how experience has been obtained :

Two of the same tubes which had served me through all the tests had been connected with new and similar rubber tubes ; that is to say, they had been cut similarly and had naturally the same length. They had both been filled with gas as related previously, but one of them had been left in contact with the air, while the other was kept immersed in water.

The depression noticed every time was, at the end of 14 days, 31.5 inches with the tube which had been exposed to the air, and of 26.4 inches with the tube immersed in water.

These last results have been repeated several times, and on several samples of caoutchouc. The results found always showed a stronger depression for the tube exposed to the air.

Determination of the Ash of the Tubes.—It seemed to me interesting to examine whether the classification of caoutchouc tubes (Table II.) presented a relation to the quantity of fixed matter contained in them. To this end I determined the ash by incineration, and was thus able to establish three very distinct classes of caoutchouc tubes, as follows :

Black,	containing	from	0.5	to	1.5 per cent.
Red,	"	"	11,0	" 12.0	"
Gray,	"	"	52.0	" 55.0	"

Comparing these figures with the classification of Table II., we see that the caoutchoucs having caused the greatest depression are those which contain the least fixed matter—black caoutchouc—and those which caused the least depression are those which contain the largest quantity—gray caoutchouc—red caoutchouc being between the other two.

Conclusions.—When illuminating gas passes through, or is in contact with, a caoutchouc tube there occurs absorption and diffusion, but more of absorption, as has been shown by Mr. Zulkowsky in the paper cited.

Practically, if required to make a choice of caoutchouc tubes, destined to carry gas to illuminating apparatus, we have a choice of two methods of testing—incineration or the siphon tube. These two methods lead to the same result. We will then select that tube containing the most fixed matter, or that which will give the longest usage before being rejected on account of the intolerable odor which it gives off in the room. The black caoutchoucs, which are the most expensive, are those which, because of the odors they give off, allow of the shortest use. I recommend, then, the employment of gray caoutchouc, and particularly the gray with a small diameter, say, 0.157 inch interior and 0.315 inch exterior, which naturally presenting a least weight of caoutchouc to the foot will absorb less gas and give off less odor.

The Permanency of Illuminating Gas.

[A paper read by MR. WILLIAM YOUNG before the North British Association of Gas Managers.]

On the occasion of our last meeting at Melrose I had the honor of reading before you a paper suggested by the special attention that had been drawn to the chemical and physical constituents of illuminating gas, in relation to its illuminating value, through the recent introduction of various new processes for the manufacture and enrichment of illuminating gas. These new processes have had a like effect in drawing attention to the relative permanency of the gas so manufactured or enriched, and to the conditions influencing the permanency of illuminating gas generally. As that subject, in one form or another, had been on several previous occasions before this and the kindred Associations of the West of Scotland, it occurred to me that these past communications might with advantage be reviewed in the light of the modern position of gas manufacture.

The permanency of an illuminating gas depends upon its vapor tension ; and this depends upon the vapor tensions of its constituents. By vapor tension I mean, as I need hardly explain to you, the tension or pressure at which a gas or vapor stands when it is in contact with its own condensed liquid at the particular temperature which we may be contemplating. In a more volatile liquid this is higher, in a less volatile liquid it is lower. Speaking generally, the heavy hydrocarbons, present a low vapor tension at ordinary temperatures, and they are more readily condensed ; light of hydrocarbons, on the other hand, present a much higher vapor tension, and their vapors are less readily condensed. In theory, if the components of a mixture of gases acted in respect to one another as simple diluents the actual pressure exerted by the gaseous mixture would be the sum of the partial pressures due to each component of the mixture ; and if you chill such a mixture each component will separately begin to condense out, without reference to the others, as soon as the partial pressure exerted by it, considered alone, is equal to its own "vapor tension." This is familiar in the ordinary deposition of dew when the temperature falls to the dew-point. In practice, with the gases with which we are concerned, the matter is by no means so simple, for the various components of coal gas do not act as simple diluents of one another. They act more like mutual solvents, and the gas acts more as a whole—as if it had a vapor tension of its own—which I call the combined vapor tension for the sake of a name. Then at any given particular temperature we must apply a certain pressure to the gas in order to induce condensation to begin ; and this pressure is the combined vapor tension which we may measure in so many inches of mercury. Now, if this requisite pressure, or combined vapor tension, is at the temperature we may have in view, less than the ordinary atmospheric pressure, it follows that at that temperature the gas will have begun to condense if we expose it to the ordinary atmospheric pressure, or a little more ; and a gas presenting this characteristic will not be permanent at that temperature, for its vapor tension will have proved itself too low. If, on the other hand, the requisite pressure or combined vapor tension, at any particular temperature, be greater than the atmospheric, we run no risk of condensing it if we expose it to that temperature at ordinary atmospheric pressures, and the gaseous mixture is then permanent.

If the combined vapor tension of such a mixed gas was such as to be in excess of the pressure of the atmosphere, at the lowest temperature and under the conditions to which such gas is subjected during storage and distribution, then according to a gas manufacturer's view such gas would be a permanent gas. If, on the other hand, the combined vapor tension was less than the pressure of the atmosphere at the lowest practical temperature under the conditions to which the gas is exposed, then a portion of the mixed gas would pass from the gaseous to the liquid or even to the solid form ; and such a gas would not be permanent from the gas manufacturer's point of view.

In order to insure permanence, therefore, the combined vapor tension must be high enough. The amount of this combined vapor tension, that is, the amount of pressure requisite to induce condensation to begin, depends upon two things. These are, first, the temperature to which the gas is exposed ; and second, the amount of solvent affinity which the respective gases and hydrocarbon vapors have for one another. Then, more than this, we find that the mutual solvent action has two other effects ; first, that so long as the mixed vapor remains uncondensed things remain in it uncondensed, being diffused, or suspended, or dissolved in our coal gas, which would have condensed, at any rate in part, if they had been pure or mixed with mere inert gases ; and second, that when condensation of any one component does not begin to take place the liquid formed interferes by its direct solvent action with the remainder of the vapor, and causes constituents of that vapor to condense out which would not, but for that direct solvent action, have condensed out of their own accord, under the particular existing circumstances of temperature and pressure.

One of my earliest contributions to this subject was made to the West of Scotland Association so far back as 1874 at their meeting at Musselburgh. On that occasion I read a paper upon "The Absorption of the Illuminating Constituents in Coal Gas by the Heavy Hydrocarbon Oils." In that paper I explained how my late brother-in-law, Mr. Cusiter, in experimenting with different fluids as a filling for wet meters, found that on filling a meter with heavy paraffine oil, the oil absorbed nearly all the illuminants ; that just as water had the power of absorbing the ammonia, so these heavy hydrocarbon oils had the power of absorbing the illuminants diffused through the gas. It was also found that on heating up, in a distilling apparatus, the oil which had been allowed to absorb the illuminants from the gas, the solvent affinity was overcome and the absorbed illuminants were set free, and that these appeared partly as a gas and partly as liquid products. It was further observed that different coals gave up to the heavy oils varying quantities and qualities of gaseous and volatile products, and that these products also varied when different temperatures were employed in the carbonizing process, and that in all cases the volatile and

gaseous hydracarbon illuminants diffused through the gas resembled the more volatile hydrocarbons present in the tars condensed from the the gas. It was further remarked that, as was well known, gases from various coals and other gas making materials were not alike permanent, some being remarkably so, whilst others were the reverse, and that the differences in permanency were due to differences in the nature of the light-giving constituents, some gases being principally indebted for their illuminating power to hydrocarbon vapors, others, again, to the presence of more gaseous hydrocarbons. It was then pointed out that the solvent affinity of the heavy oils might be applied with advantage in order to ascertain the nature of the hydrocarbons diffused in different gases, and thereby to estimate the relative permanency of these; and a method was described of applying the heavy oils to that purpose.

That paper was followed by three others, which sprung directly from the observed results of the experiments made with heavy oil in the wet meters. Two of these papers were read before the West of Scotland Association in 1875-76, the other before this Association, also in 1876. The two former papers dealt with the observed solvent affinities of the heavy hydrocarbons for the illuminants in coal gas, and the part these affinities played during the process of condensation.

In my first communication it was shown that the volatile hydrocarbon vapors diffused through illuminating gas were identical with the most volatile portions of the tars separated during condensation. In the later papers attention was drawn to the fact that if the tar was distilled, and the more volatile portions of the distillate were brought into contact with the gas from which it was originally condensed, these more volatile portions rapidly volatilized and diffused through the gas. The question then naturally suggested itself, Why were these hydrocarbons not left in the gas during the process of manufacture? In the light of the meter experiment, the cause was evident: On conducting the condensation, by allowing the gases and the heavy hydrocarbons to cool in contact with one another, the lighter hydrocarbons had been absorbed from the gases by the heavy hydrocarbons present in the tars; and it was shown that tars, if denuded of their naphthas, rapidly absorbed the illuminants from the gas, and thus reduced its illuminating power. As many of the members present will remember, those observed facts led to the introduction to the notice of this Association of the Aitken and Young system of condensing crude coal gases.

Before describing that process, and with the view of obtaining a clearer insight into the causes leading to the absorption of the illuminants from the gas by the heavy hydrocarbons present in the tars, and into the best method of conducting the process of condensation so as to prevent that injurious action, experiments were made to elucidate the physical laws coming into operation during the process. It was shown that while the vapor tension of isolated hydrocarbon fluids and the volumes of their vapors diffusible through a gas at any given temperature bore a relation to their boiling point—the lower the boiling point the higher the vapor tension, and the larger the volume of their vapors diffusible through a gas—yet, on the other hand, with commingled hydrocarbons having different boiling points, the boiling point and combined vapor tension were only about the mean of those of the mixed fluids, and varied with the relative proportions of the different hydrocarbons present in the mixed fluid. It was explained that these results were due to the solvent affinity of each hydrocarbon for the others—the solvent affinity of each hydrocarbon modifying the vapor tensions of the others. It was next shown how, on heating the mixed liquid hydrocarbons, the vapor tensions rose rapidly, and the solvent affinity was modified as the temperature rose; but that the vapor of each hydrocarbon acted as the medium through which the others diffused. It was also shown that the hydrocarbons volatilized and became simultaneously diffused through a gas in volumes of vapor bearing a relation to their boiling points and to the relative quantities of each hydrocarbon present in the mixed fluids, and that that fact explained why, as was well known, in order to obtain benzol or other isolated hydrocarbons, it was necessary to submit the tar distillate to an elaborate process of fractional distillation, whereby the vapors were subjected to repeated fractional cooling and washing by the condensed part of the distillate, such as was effected in the Coffey still.

The effect of sudden changes of temperature upon gases holding vapors in diffusion was next referred to. Gases holding vapors in diffusion, when suddenly reduced in temperature, had those vapors condensed to the liquid state, but the condensate was in such a fine state of division that it kept floating forward in a condition of fog or mist in the current of gas, and might travel long distances in that state. It was further shown that coal gases coming from the retorts, on being suddenly cooled, had the denser hydrocarbons condensed and disseminated through the gas in that finely divided condition, and that these hydrocarbons, on being carried forward into the condensers and being cooled in contact with these, were thereby enabled to absorb the illuminants. It was also shown that one of the best means of removing those finely divided suspended hydrocarbons was to bring them into intimate contact with larger surfaces, wetted with hydrocarbon fluids.

A diagrammatic table was then referred to, giving the names, the rational formulæ, and the boiling points of the crude products of the carbonizing of coal at ordinary gas producing temperatures, and attention was drawn to the manner in which it was desirable that those products should be separated or grouped so as to leave in the gas those products only which would lead to the greatest luminosity, and only leave in the tars such products as, from lack of volatility or other causes, it would be objectionable to have present in the gas. It was then explained how this grouping of the crude products could be accomplished by the Aitken and Young process of condensation, which embodied the application of these physical laws during the process of cooling the products coming from the retorts.

It is unnecessary for me to go into the details of that process, as most of those present are fully conversant with its operation. Suffice it for me to state that that process consisted essentially in a fractional method of condensing and washing. The condensed products were made to fall back against the current of products coming from the retorts, the ascending vapors and gaseous products being subjected to alternate coolings and washings by the descending current of condensed hydrocarbon products. These condensed products were kept at such a temperature as to prevent the action of the solvent affinity of the dense hydrocarbons upon the more volatile ones. These more volatile hydrocarbons were thus left in the gas. There is no doubt that the treatment of the crude gas by that process had the effect of leaving in the gas a much larger volume of the vapors of the more volatile hydrocarbons ordinarily left in the tar, and of leaving in the tars hydrocarbons previously left in the gas—in short, that a better fractionation of the products was effected, and that the resulting gas had a considerably higher illuminating power; but it was found in the town in which the process was introduced that the gas was not so permanent; that in consequence of preventing the solvent power of the denser hydrocarbons present in the tars the gases were left, so to speak, supersaturated with the more volatile hydrocarbons, and that although the combined vapor tension of the compound gas was sufficiently high to render the gas permanent at ordinary temperatures, yet, when the gas came into contact with the oil present in the leather of the dry meter, the oil asserted its solvent power and absorbed out of the gas a part of the diffused hydrocarbons, which appeared as a liquid and interfered with the proper working of the meter. It was thus shown that in order to produce a permanent gas it was better to modify the process so as to allow the solvent affinity of the denser hydrocarbons to come partly into action, and thereby to insure that the compound gas would be permanent during distribution.

The next paper bearing upon the subject was read to this Association at their meeting in Edinburgh in 1876, under the title of the "Utilization of the Gases Resulting from the Destructive Distillation of Shale in the Manufacture of Paraffine Oil." That paper explained the method of applying the observed solvent affinity of oil for volatile hydrocarbons, and the physical laws affecting the diffusion of vapors through gas, by a process the exact reverse of that described during the condensation of illuminating gas. Whereas the former process had for its object to leave in diffusion throughout the illuminating gas as large a volume of hydrocarbon vapors as possible, the latter process was to remove from the gases produced in shale oil distillation as much as possible of those volatile hydrocarbon vapors that could not be removed by simple condensation, but had been left diffused through the gas, and to obtain those vapors in the liquid form. It was explained that the process consisted in bringing dense hydrocarbon oils into intimate and fractional contact with the shale gases under conditions the reverse of those in the process for treatment of crude illuminating gases during condensation; that whereas in the former process the denser hydrocarbons were kept heated whilst in contact with the gas, and the denser hydrocarbons were drawn off at the hot end of the condensing arrangement denuded of the volatile vapors, thus leaving the vapors in the gases, in the latter process the denser hydrocarbon oil was refrigerated or cooled to a low temperature, and its solvent power was thereby increased. The cooled oils were brought into contact with the gases either under atmospheric pressure or under compression; and the cooled oil entering the arrangement met the gases nearly denuded of the diffused hydrocarbon vapors, while the oils drawn off at the lower end of the apparatus were loaded with the hydrocarbon vapors which they had

absorbed in their passage. Then the volatile hydrocarbon vapors absorbed from the gases by the dense oils were recovered, as volatile fluids, by distillation; and the denuded dense oils were thereafter cooled and returned to the apparatus, and again applied to absorb a fresh load of vapors.

By the application of that process to the shale gas, 80 per cent. of the illuminating power was absorbed by the dense hydrocarbon oils. The absorbed vapors consisted of a large number of distinct hydrocarbons, some of them so volatile as to be permanently gaseous at ordinary temperatures under atmospheric pressure. Indeed, some of these resisted a temperature so low that they were not condensed even when subjected to the cold produced by a mixture of ice and salt. Strong flasks were shown to the meeting, containing portions of the distillate which had been thus condensed by ice and salt, and which at once assumed the gaseous form on being allowed to escape into the air. It was then shown how even these very volatile hydrocarbons were held in solution by the portions of the absorbed distillate possessed of higher boiling points. Since the introduction of that process millions of gallons of such hydrocarbon fluids have been recovered from the shale gases, as also from the coal gases, in carbonizing works, and from the coking of coal. Attention was next directed to the suitability of these hydrocarbon liquids recovered from the shale gases for the carbureting of gases in order to increase their illuminating power; and it was shown that a gallon of such fluid, added in the form of diffused vapor to 1,000 cubic feet of coal gas, increased its illuminating power from 10 to 12 candles.

I need hardly say that the 20 per cent. or so of the original illuminating power left in the shale gases after treatment was due to the presence of hydrocarbons which were absolutely permanent at extremely low temperatures.

The facts disclosed in those papers showed that the permanency of illuminating gas is largely dependent upon the treatment it receives during the process of condensation, and demonstrates the important part taken in that treatment by the accompanying tars. So important is this that it is absolutely necessary, in carbonizing a hydrocarbonaceous substance for the production of illuminating gas, to restrict the decomposing or cracking-up so as to leave sufficient tars to perform the functions of washing out of the gas the sooty matter and leaving the compound gas, through their solvent affinity, with a combined vapor tension sufficiently high to render it permanent during distribution and storage. On the other hand, the temperature might be so low during the process of carbonizing a carbonaceous substance that products would be formed in which the condensible tars were in excess and also contained a greater proportion of volatile hydrocarbons than could be taken up in diffusion by the gaseous products. In that case the effects of the solvent affinity of the denser hydrocarbons would be nullified. Under such conditions the gas would leave the condensing arrangement saturated or loaded with all the vapors they could hold in diffu sion at the temperature of condensation; and therefore the least reduction of temperature beyond this, or contact with absorbent substances, would lead to their partial condensation and to a consequent loss of illuminating power.

These facts further show the difficulties arising from suddenly cooling the products of carbonization. If this be done, instead of a permanent gas, consisting of gases holding vapors of hydrocarbons in diffusion, there is produced a gas holding liquid hydrocarbons in mechanical suspension and in an extremely fine state of division. These finely divided hydrocarbons will then travel long distances, and instead of a true gas there is produced a mist or fog, which, although able to travel long distances, is yet liable to be filtered or rubbed out by mechanical contact with surfaces.

The smaller the quantity of tar present in the gas subjected to sudden lowering of temperature the greater become the difficulties; for while, when the tars are abundant the particles are more liable to coalesce, and besides, by taking up vapors in solution and thus becoming heavy, are more readily precipitated, the reverse is the case when the tars are scanty.

We have an illustration of over-carbonization when, by means of re generative furnaces, the heats upon the retorts are urged to an extremely high temperature. The lack of tar is here manifested by the stand-pipes choking with sooty carbon and by pitch accumulating in the hydraulic main, and the gas leaves the condensing arrangement so charged with naphthaline that a portion of this is deposited wherever the gas is subjected to lower temperatures. Under-carbonization is evidenced when shales and rich cannel coals or paraffine oils are cracked up at low temperatures, and the resulting gases are subject to the ordinary conditions of condensation. Such gases leave the condensers saturated with vapors of volatile hydrocarbons, and these vapors are liable to be condensed by low temperatures and the other causes previously referred to.

As is well known, however, the blending of the gases produced at extremely high temperatures with those produced at low temperatures renders the combined gases more permanent. In that case the large proportion of permanent gas present in the products formed at a high temperature tends to take up and to hold in diffusion the excess vapors present in the low temperature gas; and these vapors, in their turn, tend to keep the naphthaline in diffusion.

The third condition of matters is well illustrated in the treatment ordinarily applied to the condensation of carbureted water gas. The oil used to carburet the gas is cracked up so as to yield the maximum of carbureting hydrocarbons and a minimum of tars, and the condensation or cooling is effected by a copious contact with cold water. The process occupies only a few seconds of time, and the result of this is that although the majority of the condensible products have assumed the liquid form, they are in such an extremely fine state of division that only a portion of them can be entangled in the scrubber and carried away by the water; and that which is in the finest state of division is carried forward in the current of gases right into and through the compensation holder into the purifiers, where it is to a large extent filtered out by the purifying material. Mr. Butterfield, of the Gas Light and Coke Company, states that they have found the hydrocarbons so deposited upon the purifying materials in their carbureted water gas plant to be a source of trouble, and it is evident it must be a source of loss.

Although, however, the purifying material filters out and removes most of the suspended hydrocarbon particles from the gas, it does not entirely remove them, as was shown by an experiment I made on visiting works where a water gas plant was in operation. On allowing a stream of carbureted water gas which had passed the purifier to escape into the air, its presence was made evident by the finely divided particles present in it dispersing the rays of sunlight passing through it. Such a gas must necessarily be less permanent than if it had been subjected to fractional cooling and washing in accordance with the principles described in the papers to which I have drawn your attention. Such a gas is particularly liable to have its illuminating matter precipitated by rubbing against surfaces during the distribution; and there is no doubt these finely divided hydrocarbon particles in the gas are the cause of the fouling of the burners, and of the little filiform carbon trees which grow over the burners when carbureted water gas condensed in the manner described is used.

We have thus far considered the treatment applied to illuminating gas during the process of condensation, and its effects upon the permanency. I now wish to make a few remarks upon the mode in which the permanency may be modified during the process of cracking up the hydrocarbonaceous substances into gas.

Reference has been made to the tables of the crude products formed by carbonizing coal at ordinary gas producing temperatures, and to the portions of these which it was desirable to have present in the illuminating gas in order to render it permanent. These latter consisted of the hydrocarbons that were either gaseous at ordinary temperatures or which had a very low boiling point, and consequently a high vapor tension at the temperatures which the gas might encounter under ordinary circumstances. These desirable hydrocarbon constituents are most abundant in the products of carbonizing at low temperatures. The same temperature, however, which originally produced them will also decompose them into simple and less desirable compounds if they are long exposed to it. The other hydrocarbons simultaneously produced during the cracking process, although not within the list of those suitable, are yet capable of being cracked up into suitable hydrocarbons.

In the ordinary process of carbonizing it has been customary to employ a temperature such as will, as far as possible, crack up the unsuitable into suitable hydrocarbons whilst conserving, as far as possible, those first formed. Now it is evident that, if instead of employing that compromise between high and low temperature for carbonizing and cracking up a hydrocarbonaceous substance for the production of illuminating gas it was possible to subject the hydrocarbonaceous substance to the action of heat in such a manner that the compounds suitable for forming illuminating gas were removed from the action of heat as they were formed, and were, so to speak, filtered out from the unsuitable compounds; and then, if these compounds were further subjected to heat till they were in turn cracked up into suitable products; in that case it would, by this means, be possible to produce from a given weight of hydrocarbonaceous matter a larger yield of luminous matter of a more permanently gaseous character.

Mr. Bell and I had the honor of bringing such a process under your notice at our last meeting in Dundee in 1893. At that meeting it was

shown that an illuminating gas produced at low temperature, supersaturated with hydrocarbon vapors, and therefore not permanent, could be rendered perfectly permanent by the application of the solvent action of the hydrocarbons upon each other. We showed that the liquid hydrocarbons could be, so to speak, used as a filter or sieve to separate from the gas all those products which would prevent the gas being permanent, and would act as the medium of transporting them back to the retort to undergo further cracking, until the whole gas producing material was ultimately converted into two products—namely, permanent gas of high illuminating power.

By altering the amount and surface of the hydrocarbon applied in the fractional condensing and washing process, the degree of volatility of the hydrocarbons left in the gas can be altered at will to suit the purpose to which the gas has to be applied. If the gases are to be used to carburet a poor gas through which hydrocarbon vapor of compara tively low tension and small volatility will freely diffuse, the washing with the hydrocarbon fluids is limited so as to allow such to pass away along with the gas. If, on the other hand, these heavy hydrocarbons of low volatility would be objectionable in the gas, the washing with the liquid hydrocarbons is increased so that only hydrocarbons having a high vapor tension pass away with the gas. Those of low tension are then taken up in solution by the liquid hydrocarbon and are carried back into the retort to be further cracked up into those having a higher vapor.

In the papers which we have just reviewed the consideration of the physical laws affecting the vapor-tension of a compound gas has been confined to hydrocarbons which necessarily pass from the vaporous or gaseous into the liquid state; and it was shown that in consequence of the solvent affinity of such hydrocarbons for each other the vapor-tension of mixed hydrocarbons stood only at a mean between those of the commingled fluids, and that the respective vapors diffused through each other and through a gas in volumes which bear a relation to the respective vapor-tensions and to the respective quantities of each hydrocarbon present in the mixed fluids. Such being the case, it is evident that upon the addition of the vapor of a liquid hydrocarbon to a gas already containing vapors in diffusion, any one of whose vapor tensions was just sufficient to hold it in diffusion and no more, then, unless the vapor-tension of the added hydrocarbon vapor was sufficiently and in most cases extremely high, the tendency would be for the added vapor to cause the precipitation of a part of the denser vapors already present in the gas. My object in drawing attention to that point is that there is an idea, and a growing idea, that the addition of a vapor of a liquid hydrocarbon to ordinary coal gas has the property of, in some occult way, raising the vapor-tension of those hydrocarbons already held in diffusion through the gas, and more particularly that of the vapor of naphthaline.

That latter idea may possibly be true with regard to naphthaline, for naphthaline is one of those hydrocarbons which can pass directly from a state of gas to that of a crystalline solid; and on a former occasion I have shown you, in connection with another subject, that such sublimable crystalline solids lose, to a large extent, their solvent affinity for vapor and gases; that air nearly saturated with the vapor of bisulphide of carbon may be passed through a deep layer of crystalline sulphur, a substance extremely soluble in bisulphide of carbon, without its being deprived of its diffused vapor; and that coal gas, even of fairly high illuminating power, may be passed amongst pure crystalline naphthaline without having its illuminating power appreciably reduced, whilst the liquid hydrocarbons from which the naphthaline was filtered, and which had a similar boiling point, rapidly denuded the gas of its illuminating power when brought into contact with it. It may therefore be possible that the vapors of naphthaline are subject to some modification of the physical laws affecting the diffusion of the vapors of liquid hydrocarbons in coal gases; that just as naphthaline loses its solvent affinity for vapors on assuming the solid crystalline form, so may its condition in the gaseous state be differentiated so that it is held in diffusion in a different manner from other hydrocarbons. I am afraid, however, that the high enriching results that have been obtained and have led to this idea being supported, have been due, not directly to true diffusion of naphthaline vapors through the gas, but to the presence of enriching hydrocarbon vapors. The presence of these vapors would lead, at higher temperatures, to the naphthaline being taken up in a diffused condition, again to be deposited as solid naphthaline on the temperature falling, but in such an extremely fine state of division that it is carried forward with the gas, much in the manner already referred to.

Many years ago, in connection with the manufacture of pneumatic gas, I made a great many experiments with the object of discovering some means of getting that cheap carbureting agent, naphthaline, to remain in diffusion in air and to form a part of the carbureting medium, in association with other hydrocarbon vapors presenting high vapor tensions; but with negative results only. The naphthaline was invariably precipitated until only a mere trace of its vapor was left in diffusion, and the precipitated portions, under certain conditions, assumed the extremely fine state of division to which I have referred. The fact that the addition of the vapors of liquid hydrocarbons, in quantities considerably short of saturation, does not prevent naphthaline deposits during the distribution of the gases, is further negative evidence as to the effect of these vapors holding the naphthaline in diffusion any further than the additional tension which they communicate to the compound gas would lead us to expect.

In conclusion, I may be allowed to remark, in regard to the commercial aspect of the subject, that in estimating the value of a gas producing or gas enriching process, the permanency of the resulting gas should form one of the main factors. It would be unfair to compare a process which produced a perfectly permanent gas—capable of reaching the utmost limit of supply without material alteration, and thus of insuring that all consumers will receive a like value and of preventing the possibility of the imposition of penalties—with a process in which the lack of permanency in the resulting gas made it necessary that the gas should be sent from the works considerably higher in illuminating power than the standard in order to insure that the gas may be able to pass the testing stations without the imposition of a penalty, or in which there may be a loss of a proportion of the added enrichment before the gas reaches the consumer, a proportion which amounts in some cases to as high as 50 per cent.

Experiments in the Diminution of the Amount of Naphthaline in Coal Gas.

The London *Journal* is responsible for the following abstract translation of an article, by Herr V. O. Keller, in the *Gastechniker*, in which the author described a series of studies made by him respecting naphthaline in coal gas:

The means hitherto commonly employed for preventing stoppages in mains from the deposition of naphthaline, such as the injection of gasoline, etc., have been of only temporary service in delaying that result. The power which gasoline possesses of taking up large quantities of naphthaline suggested that a certain quantity of it might be carbonized along with the coal. To this procedure there were two objections—viz., its costliness and the danger. Therefore, the cheaper and less dangerous crude petroleum was tride in place of gasoline. A setting of seven retorts with old pattern mouthpieces was used. A 2-inch perforated wrought iron pipe passed through the lid, and extended two-thirds of the length of the retort. Outside, the pipe was reduced to ½-inch, and attached to a U-tube and funnel, into which the petroleum dropped. When petroleum was led into the retort at the commencement of the distillation, the pressure of gas became too great. Therefore in later experiments it was not admitted until the second hour after charging. The petroleum supply was cut off at the end of the third hour; the charge being completely burnt off in four hours. About 14 gallons of petroleum were used per retort per charge.

The following were some of the consequences of the carbonization of petroleum in the retorts. An oily layer appeared on the surface of the water in the gauges of the station meter, and a viscous fluid, smelling strongly of naphthaline, was taken from the holder siphons. A holder which was not used on Sunday had a deposit of naphthaline crystals round its lower rim when it was again put into action. Crystals appeared at the valves, seals, etc., and on the plates of the holder; and finally the petroleum, saturated with naphthaline, reached the dial of the meter. It was evident that the petroleum attacked the naphthaline energetically, but deposited it in places where its removal could not readily be effected. Later, a thick liquid containing petroleum and naphthaline was removed from the street siphons. It seemed that much of this naphthaline had been previously present in the mains; and as a means of cleansing these, the petroleum proved very useful, though it did not appear to be efficacious in preventing the formation of naphthaline for any length of time. It had the advantage of enriching the gas.

Dr. Bunte has pointed out that naphthaline may be removed from gas by condensation, but at the risk of injury to the illuminating power. While the above trials were in progress, it appeared to the author that the nature of the purifying material used influenced the separation of naphthaline. The matter was investigated by leading gas through a

small purifier, one side of which was of glass, into a glass tube cooled to 0° C., and thence to a burner. Six experiments were made, and the glass tube was thoroughly cleansed after each one. The purifier remained empty in the first, and a naphthaline deposit was noticed in the tube after some hours. The purifier was then partially filled with gas oline, and no trace of naphthaline was found in the tube in 36 hours The gas burnt with a very luminous but smoky flame. With the purifier charged with lime, traces of naphthaline were seen in 24 hours. With Laming's purifying material, naphthaline was scarcely found in 24 hours. With another purifying material, consisting almost solely of hydrated oxide of iron, from a gas works where stoppages in the mains were very rare, there was no deposit of naphthaline in 48 hours. With a mixture which consisted when dry of 17 parts of silica, 28.3 parts of alumina, 34.6 parts of ferric oxide, and 19.8 parts of soda, and in which the alumina and soda appeared to be present as insoluble sili cate, the tube was completely choked with naphthaline in six hours.

These very varied results leave no doubt that the purifying agents used have a relation to the amount of naphthaline left in the gas; and the nature of the purifying material has evidently more bearing on the question of naphthaline deposits than was formerly supposed.

Hints on Foundry Operations.

A "Foundry Foreman," in presenting some very readable suggestions regarding the right methods for directing the routine of everyday foundry work, remarks:

One of the most essential things in a well-regulated foundry is adequate means of ventilation, that the great volume of noxious gases almost constantly hanging about a foundry may be readily and efficiently carried off and pure air supplied without creating a dangerous draft. Another is plenty of light, and always from above. It means greater satisfaction and peace of mind to the molder, and greater economy to the "boss." Who has not seen the molder waste a handful or two of flour and poke around for half an hour with a lifter and a looking-glass, or, worse still, with an ill-smelling coal oil lamp, when a few good skylights, kept clean, would have obviated nearly all of this maneuvering? But with many the principle seems to be that anything is good enough for the foundry. As will be seen, these strictures apply more particularly to the jobbing or machinery foundry, especially where lots of cores are used. A little careful calculation will prove that the cost of flour, coal oil, gas and molder's time used and wasted in a badly lighted shop will in a year pay for a few extra overhead windows, and materially lessen the risks and losses. Plenty of fresh air and pure sunlight will prove a paying investment and keep the molder in a condition to give the greatest satisfaction.

Next in order comes the necessity for keeping the foundry clean and orderly. Have some system about it. Have a place for everything, and a clean and well-defined gangway. Don't have great piles of dry sand or big holes here and there about the shop, unused boxes lying around in the way of everybody, the rapping bar and sledge somewhere, and the "gaggers" out of sight. But you say the proprietor won't give you help enough. Prove to him the economy, and you will get the help. Compare the molder's wage of from 25 cents an hour and up with the laborer's wage of 15 cents for doing the same work, and he is blind indeed who will not see. There is a practical way of doing everything, and this is one whereby the proprietor saves money, the molder's work is expedited, and his safety at night when carrying iron is incalculably increased.

And now let us glance at the core room. Secure a first-class core maker, and pay him well when you get him. He is a treasure, and takes a load of anxiety from the mind of the foreman, and more than saves his wages in a week. Be careful of the small leaks even here, for every one of them adds to the cost of production and can just as well be stopped. Don't throw away the unburned pieces of old cores. I have seen enough such lying on the dump in the foundry yard to keep a good-sized foundry supplied with cores. Throw them in a bin made for the purpose, and wet them down two or three times a day, so that the coremaker can use them in a day or two. If mixed in with fresh sand no harm will ensue, and a saving of flour, etc., will be effected.

From the core room we step to the cupola, and find a similar essential to be in demand—namely, a good melter. But don't depend on him alone in the mixing. Give it your personal supervision, for in these days of uncertainty as to the quality and properties of what purports to be the same brand of pig iron, you cannot be too watchful in order to detect its weaknesses and remedy them. We have not only the manufacturer of pig iron to distrust in this case, but not infrequently our own employer, who we know to our sorrow will palm off the cheapest brand he can get, and expect the foreman to turn out first-class castings, both in point of strength and appearance. If he gives you two or three different brands, the safest way is to take equal parts of each and add as much good scrap as you have pig, so that it is half pig, half scrap, and the chances are in your favor of getting a good grade of iron for engine and general jobbing castings, and for boiler, radiator or furnace work, by a little careful experimenting. But don't forget to watch the charging yourself. It is your most reliable authority, and is the proper time and place to mix iron and intelligently approximate results.

It is often carelessness as to small things that costs the most. Thus we find in many foundries the molders wasting an hour and upwards of valuable time every morning in doing what can readily and equally well be done by the laborer at nearly one-half the cost. I refer to the taking out of castings and wetting down and cutting over the heaps. I have always had laborers go in early in the morning and do this work, and find that besides effecting a saving in wages, it gives the sand a chance to cool off and become properly tempered before being used, and to those who know the evil effects of using hot sand on good patterns this is no small advantage. I have had as high as 13 tons of castings taken out by two helpers in two hours.

One great source of loss, more especially in small jobbing foundries that have not a well equipped carpenter shop in connection, is the poor quality of the flasks supplied to the molder. Some think they are economizing by giving him a flask that is only fit for firewood, instead of incurring the expense of a new flask. In nine cases out of ten the piece is lost and then a flask is made. Every shop should have a foundry carpenter, one who knows how to make and bar a box so as to be firm and fit the pattern. A handy carpenter, plenty of lumber and nails, and you have supplied the molder with the foundation of his success. Economy in these lines is expensive in the end.

Successful management of a foundry requires that the foreman look after all details himself. It is an old maxim that if you attend to small things big things will attend to themselves, and this might with profit be applied to the running of a foundry. The foreman must at all times keep a cool head. An accident or loss can never be bettered by allowing one's feelings to get the better of his judgment and becoming "rattled." It only increases the chances of further loss.

The Rights of Electrical Companies.

[A paper read by Mr. W. Clyde Jones, before the semi annual meeting of the Northwestern Electrical Association.]

A few decades ago electricity was a laboratory force, and electrical devices were toys not designed for serious use. To-day electricity has pervaded every industry, and millions of dollars are invested in electrical operations. While inventors and engineers have busied themselves in expanding the application and the utility of the force, the bench and bar have been busy in endeavoring to adjust the world to the new life which electricity has introduced. For every individual born into the world society must adjust itself, and feels the effect of his presence just as the earth vibrates and planets swerve from their courses when an apple falls to the earth. Just so the birth into the world of every new device introduces a new set of conditions which conflict with or modify existing conditions and necessitate the application of the adjusting hand to bring the new into harmony with the old by the modification of one or both. The introduction of electrical apparatus has been so rapid that more or less confusion and conflict of opinion have accompanied the attempts to solve the legal problems arising, but while the decisions of the courts have been at variance, a general tendency may be traced through the opinions which points to a possible future concord.

Outside of the telegraph, electricity has been an element of industry for but little over 20 years, yet so many have been the questions raised that already half a dozen text books have been written on purely electrical subjects, while four large volumes contain the decisions upon strictly electrical subjects, not including litigation upon electrical patents, which would fill several times as many volumes.

It is the design of the present paper to outline the course of judicial decisions in a manner to be of service as general knowledge to business men and engineers engaged in electrical pursuits. The subject will be discussed under three principal heads: (1) The relation of the electrical industry to the governing power upon whom it depends for the exercise of the essential franchise for the use of the streets and highways

(2) The relation to private persons and abutting property owners; and, (3) The relations between various companies, electrical and otherwise, which conflict in the exercise of their franchises.

There are few electrical pursuits which do not require for their proper exercise the enjoyment of a public franchise, as the right to use the public streets or highways for the placing of their wires and conductors. The obtainment and enjoyment of such a franchise bring the electrical company into contact with the governing power of the community. Wires placed on the public ways without the consent of the governing power may be removed as a nuisance. Authority from the proper power must be secured, although the use may be a proper street use. All power for the granting of franchises lies primarily in the State, subject to the restrictions of the Federal Constitution and lawful statutes of the United States. To the extent not restricted by the State Constitution, also, the Legislature has the power to grant the use of the street for a special purpose. The grants are usually made subject to control by the municipal authority as to the manner in which the franchise is to be exercised, as for instance the streets upon which the franchise shall lie, the nature of the construction, and the like. In some cases the Legislature delegates to the municipality the authority to grant as well as control the use of the public way for the special purpose.

But though the government may permit the company to exercise a franchise, the franchise cannot be exercised in derogation of the rights of others without due compensation therefor, and this brings into consideration the much vexed question of the relation of the company to the abutting property owner.

Two theories exist as to the relation of the abutting property owner to the street. In some instances an easement or right of passage has been granted to the public while the ownership of the fee to the land over which the street extends remains in the abutting property owner, the property owners on each side of the street owning to the middle of the street. In other cases, the fee to the land over which the street passes remains in the public and the property owner acquires the property with the privileges of the street as to right of access and egress, light, air and comfort. This difference in view as to the relation of the property owner to the street has resulted in different conclusions by the courts as to whether a certain special use does or does not impose a new burden on the street such that the abutting property owner is entitled to compensation. Where the ownership of the land on which the street lies is in the public a special use of the street has been held to be a proper use not imposing a new burden, while the same use has been held to impose a new burden where the ownership of the land to the middle of the street is in the abutting property owner. This distinction, however, as to the different relations of the abutting property owner to the street has of late years been losing force, and the weight of authority of courts and text book writers tends toward the obliteration of this distinction and toward the consideration of the subject solely with reference to the rights of the abutting property owner to the enjoyment of the street for ingress and egress, light, air and comfort, any special uses which materially affect these rights being additional burdens requiring compensation to the property owner, while special uses not materially affecting these rights are proper uses without compensation.

This modern view relieves the inquiry of the legal subtleties and reduces the inquiry to a simple question of fact as to whether the new use does or does not affect the enjoyment of the street by the property owner, and, if so, to what extent? To fully comprehend the nature of the special uses which the electrical industry imposes on the streets a study of the evolution of the street will be of assistance.

From time immemorial, since men first felt the advantage and the necessity of living together in communities, public ways have existed. Individuals have appropriated parcels of the soil upon which have stood temporarily or permanently the wigwam, the hut, or the house, while thoroughfares have been unconsciously or designedly left to permit passage to and from the abodes. Everyone has had the right to pass over the highway in the conduct of his business or pleasure. Not only could he pass over the highway himself, but he could carry his bundles and the other accessories of his life with him.

The first servitude upon the street or way was the right of passage, and with this little conflict could arise between passing individuals, as each could easily exercise his right without interfering with the rights of others. When, however, the way came to be used for semi-commercial purposes and men began to carry their burdens of game or product on their backs, a new servitude was introduced, for the unburdened man must surrender the right of way to the man carrying a burden. The law of custom thus gave to the burden carrying man the right of way, and introduced a new servitude on the street, and as this new use did not injure the abutting property owners, but was rather essential to his proper enjoyment of the street, the property owner acquiesced in this new burden.

The next servitude upon the highway arose when horses and other pack animals were introduced for conveying individuals and for commercial purposes. The pedestrian, being the weaker, must give way to this new and special use of the street, and the pack animal acquired the right of way.

This new use being in accordance with the rights of abutting property owners, they made no objection to this new burden imposed upon the streets. Subsequently the pack animal became inadequate for the advanced needs of mankind and the sled and wheeled vehicle came into use, acquiring a right of way over pedestrians and pack animals, and established a new servitude which came to be a proper use of the street. Conflict between passing vehicles led to the custom whereby passing vehicles swerved to the right, and conflict between the vehicles and pedestrians led to the setting apart of the middle of the street for vehicles and draft animals and the use of the sides of the streets for pedestrians. Furthermore, the employment of wheeled vehicles necessitated a smooth and even road, and a new burden was imposed upon the abutting property owner in keeping the highway in repair. Likewise the necessities of pedestrian travel imposed a burden upon the property owner in keeping the sidewalk in repair. Thus, by degrees, the street has assumed its present condition.

As civilization advanced and the spheres of action of men widened and it became necessary to provide means for transporting passengers over considerable distances along a definite route, and stage coaches and omnibus lines appear, which require a right of way over other vehicles, due to the high speed at which they must be run or due to the cumbersomeness of the vehicles. The necessity of transportation along defined routes within the city led to the grant of exclusive franchises for the running of 'bus lines between certain points or along certain streets or highways. This is perhaps the first appearance of the franchise in the operation of street transportation companies. This movement along established lines led to the adoption of the plank road, so prevalent several decades ago, which was prepared to facilitate the travel of the heavy vehicles, having a fixed path of travel. The next logical step was the laying of rails for the travel of the wheels of the vehicle, thus introducing a new servitude and rendering this portion of the roadway more or less incapable for use by other vehicles, or making such use subsidiary when possible. In addition, the abutting property owner was affected by the increased noise and commotion, and his ingress and egress were to a degree affected. The courts have generally held, however, that the horse railway is a proper use of the street for the original purpose of transportation and does not impose a new burden necessitating compensation to abutting property owners.

With the advance of civilization it was proposed to dispense with the horse and substitute some other form of motive power. Modeling after the steam railway, steam motors were the first introduced, but the puffing of the engines and other accompanying noises frightened horses and otherwise interfered with the proper use of the street for steam street railways practically an exclusive use, prohibiting the other and ordinary uses. Courts have generally held, therefore, that steam street railways for passenger or commercial transportation are not proper uses of the street. In addition to the noises, the tracks required have been of such form as to prevent the use of the right of way by ordinary vehicles.

While steam motors on the train have not been to any great extent used for urban transportation, the centralized steam plant in the form of the cable system has been extensively used. This necessitates the laying of a conduit in the road, and the provision of a narrow slot which prevents the full and complete use of that part of the roadway between the rails, particularly by single horse conveyances, while oftentimes catching the shoes of horses and causing accident. Furthermore, more or less noise is produced by the travel of the cable, causing discomfort to adjoining property owners. The courts, however, have mostly held this to be a proper use of the street, imposing no new burden.

Historically, the electric railway is the successor of the cable road. In the form in which it has been generally introduced the electric railway requires for its operation, in addition to the track of the horse railway, certain poles placed at the curb or in the middle of the street, and conductors and trolley wires strung thereon. Whether or not these poles and wires introduce a new servitude has been a hard fought battle, resulting in a decision in the affirmative in some of the States and in a decision in the negative in other States. The most approved tendency, however, is toward the view that the electric street railway with its

auxiliaries of poles and wires does not impose an additional burden upon the street for which the abutting property owner must be compensated.

With the growth of cities, and the removal of residence districts to a distance from the business center, has appeared the elevated road, operated originally by steam locomotives and lately to an increasing extent by electricity.

The elevated road requires a superstructure which obstructs the streets to a considerable extent, affects the right of ingress and egress, darkens the street, and in many ways affects materially the owner of the abut ting property and his enjoyment of the street. The courts have held that the elevated road is such a special use of the street as introduces a new servitude and that abutting property holders are entitled to compensation.

The uses of the street thus far discussed are such as pertain to transportation along the street, to the direct passage of individuals and commerce or the vehicles for carrying the same. Whether the streets could be used for purposes other than those of transportation was a question that arose as soon as the advance of humanity demanded sanitary cities. The street seemed the natural location for sewers to drain abutting property, and thus arose the question whether a man must submit without compensation to the placing of a large sewer in front of his premises, not alone for draining his own property, but also that of other parties along the street. The use of the street for sewage purposes was deemed a public necessity and became a proper street use imposing no new burden requiring compensation.

Water pipes were next laid in the streets for supplying private individuals and for supplying hydrants for fire purposes. This was a new use beyond the original object of the street for transportation purposes, but since the water mains were used for a public purpose, that of supplying water for fire purposes, the placing of the mains in the street was held to be a proper use, even though the mains were used incidentally for supplying private consumers.

When gas for lighting purposes was introduced the same questions arose, and as the gas mains were used for supplying gas to street lamps, this was declared to be a public use such that it rendered the employment of the street for the gas mains a proper use, notwithstanding the mains were also used for private lighting.

When electricity was introduced for lighting purposes the same objections were raised, though with added force since the poles and lines employed were more objectionable than the buried gas and water pipes. As the same conductors were also employed for supplying current to street lamps, it was argued that this was a public necessity, and therefore a proper use of the street. Where the plant is owned by the municipality the placing of the poles and wires in the street has been held to be a proper use, imposing no new burden. Where the plant is owned by private parties, though used for street lighting, some courts have held the use of the streets to be a proper use, while others have held to the contrary. Where private plants have been used for private lighting only, there has also been a division of opinion. The tendency of decision, however, is toward the view that the use of the street for electric light wires is a proper use of the street, not imposing a new burden on the street such that abutting property owners must be compensated.

In the early use of the telegraph, the pole lines were run along railway rights of way, and as the telephone and electric light wires were not present in the cities to co-act with the telegraph in burdening the streets with an over-abundance of wires, few questions arose between the companies and property owners. With the extensive use of pole lines the question has arisen as to whether the telegraph lines are a proper uncompensatible use of the street. It is argued that the telegraph is not a use of the street for its original purpose of transportation, and therefore introduces a new burden. On the other hand, it is argued that the use of the streets for the carrying of the mails and the carrying of messages is one of the contemplated uses, and as the telegraph serves the same purpose, thus relieving the streets to that extent, the telegraph is a proper street use. The weight of authority is in favor of the view that the telegraph is without the scope of the proper uses of the street, and is such a special use that the abutting property owners are entitled to compensation for the new servitude.

The telephone has also called the streets into service for its pole lines and has been attacked on the same grounds as the telegraph, since the telephone is but one form of telegraph. The argument may be made with more force, however, that the telephone assists in the use of the street for transportation purposes, since the many telephone conversations relieve the streets of the passage of the individuals who would otherwise have to meet in order to hold the conversations. The tendency of decision is nevertheless toward the view that the telephone imposes a new burden on the street for which the property owner is entitled to compensation.

Considering the conflicts which arose in the operation of electrical franchises, the first disagreement arose between the telephone companies and the electric light companies. The variations of the currents used for electric lighting induced currents on the telephone lines where the lines ran parallel, thus introducing disturbances on the telephone lines, materially impairing the operation of the telephone system. This disturbance led to suits by the telephone companies against the electric light companies. As the inductive effect could be prevented to a sufficient degree to permit operativeness by separating the conductors of the two systems to a proper distance, this conflict was settled by regulations preventing the electric lighting companies from placing their wires within the disturbing inductive distance of the telephone wires, while on the other hand the telephone companies could not complain if they placed their new lines within the defined distance of the electric lighting lines already constructed.

A more serious controversy, however, arose between the telephone and the electric railway. Most of the telephone lines had ground returns, thus employing the earth as a part of the electrical circuit. The electric railway likewise employed the earth as a part of the circuit, and the earth at different points along the electric railway was thus charged to a considerable difference of potential, such that telephone lines grounded in the vicinity of these points were traversed by currents which rang the bells, operated the apparatus and otherwise disturbed the system. At the same time trouble was experienced by the inductive action of electric railway currents upon the telephone lines. The telephone companies brought suit against the electric railway companies to enjoin the use of the earth as a part of the electric circuit of the railway. It was claimed that the electric railway could be operated by storage batteries or by the double trolley system without employing the earth as a conductor. On the other hand, it was argued by the electric railway companies that the storage battery as a means of propulsion had proven unsatisfactory and uncommercial, and that the double trolley system existed only in theory and had not been practically and successfully used; and that the single trolley system, with the use of the rails and ground as a portion of the circuit, was the only practical means of propulsion available.

Again, it was pointed out that the telephone companies could avoid the disturbance from vagrant or ground currents by substituting a common wire return instead of using the earth, and that troubles from vagrant currents as well as inductive disturbances could be avoided by the use of completely metallic circuits, employing both a metallic outgoing and metallic return wire situated at the same inductive distance from the disturbing conductor, whereby opposing and neutralizing currents are induced in the telephone lines, and all disturbances thus avoided. Furthermore, it was pointed out that the electric railway was a use of the street for the original purpose of transportation, while the telephone is a use not contemplated in the original purpose of the street, and therefore subsidiary to the use by the electric railway. While there has been some conflict in the decisions, the prevailing opinion is that, since the telephone company can prevent the disturbances by the adoption of the metallic circuit, and since no one can have an exclusive monopoly in the use of the earth as a conductor, and as the double trolley system is not at the present stage thoroughly practicable for general use, the telephone company should change to the metallic circuit.

The advantages in the use of metallic circuit for telephone purposes are coming to be more appreciated, particularly in large cities where the service is improved more than in proportion to the increased outlay, and this decision against the telephone companies is not felt as a hardship. Furthermore, the extension of the long-distance telephone system, with its metallic circuit which will connect with none but local exchanges having metallic circuits, emphasizes the desirability of metallic circuits.

The next serious conflict arises between the electric railways and water and gas mains. The earth currents of the electric railways leave the rails in seeking a more direct route to return to the power station, and, choosing the path of least resistance, travel along the water and gas mains when they lie in the vicinity. As the current leaves the metallic mains an electrolytic action results, the metal and the earth being the poles of the cell, while the moisture of the earth holding in solution certain chemicals forms the electrolyte. The result is the decomposition of the metallic pipes, resulting in the eventual destruction of the pipes. Suits have been brought against the electric railway companies for damage done to the mains, but as yet no decisions of the ultimate courts have been reached. It is argued by the owners of

these mains that the electric railway company must use its own in a manner not to interfere with the rights of others, and if the use of the ground as a part of the electric circuit results in the destruction of the mains, provision must be made to prevent such destruction or the use of the earth must be abandoned. Furthermore, it is argued that the use of the street for water and gas mains is a recognized proper use of the streets, and as in most cases the franchise for the placing of the mains was acquired prior to the grant of the franchise to the electric railway, the use for the placing of mains is a prior use and takes precedence over the use for electric railway purposes.

On the other hand, it is argued that the use of the street for electric railway purposes is within the original purpose of the street, that of transportation, while the use of the street for mains is without the scope of the original purpose of the street, and therefore secondary to the primary uses of the street of which the electric railway is one.

It is a well established doctrine that every one should so use his own as not to interfere with the rights of others, and it would therefore seem to be the duty of the electric railway companies to so operate their systems as not to interfere with mains laid in the street, and, if the use of the ground circuit is essential, to devise some means to prevent deleterious action upon the pipes. A number of methods have been proposed which are claimed to prevent the destruction of the pipes, and if this be the fact, the question arises whether the courts will not hold the electric railway companies responsible for damages done to the mains when it is within their power to prevent such damages by the employment of available means.

The Legal Duties of Engineers and Architects.

In the course of his address before the Engineering Association of the South, the Hon. Jas. C. Bradford, President of the Association, remarked: It would be difficult to exaggerate the importance of the duties and functions of architects and engineers. In the practice of their professions technical skill and learning, good judgment and honesty are necessarily required. No science that I know of is more difficult to master or requires, in practice, a higher order of ability than those of architecture and civil engineering.

If a man holds himself out to the world as an architect he is presumed to be qualified in every proper sense. His client necessarily relies on his skill. If, therefore, he should be wanting in skill, and, in consequence, his client suffers injury, he would be liable. The relation between the architect and his employer is similar to that of lawyer and client or of physician and patient. The professional man who is employed as such by another must bring to the task he has engaged to execute all the skill and learning necessary to do it. It would be a gross fraud and great injustice to permit an architect or engineer who had been employed by another, confiding in his skill, to escape the consequences of his own ignorance and unskilfulness. The rule rests upon the broadest principles of equity.

Besides learning and skill, an essential quality in an architect or engineer is honesty. The law requires the observance of the utmost good faith on the part of the architect to his client. An unfaithful architect could easily bring upon his client ruin and disaster, without the ability on the part of the latter to avert it. One of the commonest rules of the law of principal and agent is that a man shall not serve two masters. It has sometimes happened that architects and engineers have undertaken to serve the man who employed them to design and superintend the construction, and at the same time have taken a fee from the contractor. Such contact is reprehensible both in morals and in law. One of the consequences of the violation of this rule is that the architect is not permitted to claim compensation for his services, however meritorious, from either party. The law forfeits his compensation as a just penalty for his unfaithfulness.

An architect, while bound to observe the best faith to his employer, the builder, is bound to treat the contractor fairly. He cannot exercise his power so as to wrong or defraud the contractor. Thus where, by the building contract, the architect or engineer is made the arbitrator of differences between the proprietor and the contractor, his position is that of a judge, bound to act with impartiality; and if he should make an agreement with the proprietor to give him the advantage in his decision such agreement would be illegal, and his decision or award would be void. Where the architect is made an arbitrator he ceases to be the agent of either party, and his decision must be made in a spirit of fairness, and without regard to his former relations.

Where the architect or engineer is employed by the proprietor or projector to superintend a proposed work the relation of principal and agent is established. It oftentimes becomes a matter of importance to define the limits of the agent's authority and to what extent he may bind his principal.

The general rule is, that in the absence of stipulations to the contrary the authority of the architect will be determined by the character of the work, and the objects intended to be accomplished.

One limitation upon the power of an architect or engineer seems to be without exception. Where it is not expressly permitted he cannot delegate his authority to another. The position of an architect or engineer is one involving special trust and confidence in his skill and honesty, and if he were permitted to assign his duties or substitute another in his place injustice and wrong would often be done his employer.

An architect transcending his authority makes himself personally liable to the contractor. He is presumed to know the extent of his powers better than the contractor, and if the latter does work at the instance of the architect which he had no authority to order he will be personally liable.

It becomes the duty of the architect and engineer, during the progress of the work, to issue to the contractor what are known as progress certificates, and, when the work is completed, to issue final certificates. These certificates are evidences to the owner of the progress of the work and of the right of the contractor of payment. Most contracts provide that payment shall be made only on the certificate of the architect or engineer, and the issuance of the certificate thus becomes a condition precedent to payment. The certificate, when issued, is binding on both the owner and the contractor, and unless it can be shown that the architect acted fraudulently or corruptly neither party can complain. The decisions have gone to the extent that, where the certificate is made a condition precedent to payment, the contractor cannot maintain a suit unless he produces a certificate. Of course, where the certificate is corruptly and unreasonably withheld, the contractor may, upon averring that fact, bring suit. And the architect may make himself personally liable by capriciously and wrongfully withholding the certificate.

A usual stipulation in contracts is that the work shall be completed on or before a certain time. Accompanying the stipulation as to time there is usually, and ought to be, a stipulation subjecting the contractor to the payment of a certain sum as liquidated damages in case of failure. Such provisions are wise, because they act as a spur on the contractor. The propriety of fixing an amount as liquidated damages in case of default is apparent when you remember that unless the damages are agreed on they can hardly be settled without litigation. Where a certain amount is agreed on in the contract as liquidated damages there is no room for controversy. Such provisions have been uniformly sustained by the courts.

Where the contract is silent as to the time of performance the law infers that a reasonable time is meant.

The stipulation as to time in a contract may be extended or waived, and such waiver or extension may be in parol—that is, not in writing.

It is a general rule that a building contract cannot be specifically enforced; that is to say, the contractor cannot be compelled, against his will, to perform or complete, nor can the other party be required to permit the contractor to do the work. If the parties choose to disregard the contract they may do so, but at the risk of being called upon to pay damages.

The question that has given architects most trouble, and occasioned most controversy and litigation, is extras. It is a common saying that a house usually costs double the contract price because of extras. Dearly bought experience has caused the insertion in most building contracts of special stipulations to avoid them. The usual provision is that no alterations or additions shall be made without the consent of the owner. Sometimes it is provided that the consent shall be in writing. The architects are sometimes hedged about with very stringent restrictions; a common provision is that no addition or extra shall be made or allowed by the architect. When he is authorized to do so it is usually provided that the architect shall agree to it in writing. The owner may, of course, waive the stipulation forbidding extras, and he may do it as he pleases, either in parol or in writing. But the architect has no such authority, except with the consent of owner. If he should waive it the owner would not be liable for the extras, and the architect might be liable in damages to the contractor for authorizing them.

The builder is bound to scrupulously follow the specifications, and cannot justify a departure therefrom by substituting other details, although as good as those called for. He is as firmly bound by the terms of the specifications as by the covenants of the contract, for they are, in fact, a part of the contract. Nor can the architect change

them, except by special authority from the owner. Where there is obscurity in the drawings and specifications the contractor must apply to the architect for directions, or he undertakes the work at his own peril.

Where, however, the work has been performed in full compliance with the specifications no responsibility will attach to the builder if the structure falls, or is practically worthless owing to defectiveness and insufficiency of the plans and specifications. It is the contractor's duty faithfully to execute the work for which he has been engaged, and he is not responsible if the undertaking is valueless, nor is he liable for any defect in the building caused by defectiveness in the plans furnished him by the owner. So far as the plans are adopted by the owner they become his, and he is responsible for claims accruing to the contractor or others for defect in the plans.

I have diverted to the question of damages. It may not be improper to note a distinction on this subject which, perhaps, is not known to all of you. Although the parties to the contract have a perfect right to determine, beforehand, what shall be the damages which shall be paid to the other by the one who violates it, the law does not enforce such agreements when they amount to the imposition of a penalty or forfeiture. Where the amount stated to be paid for a breach of the contract is evidently what the parties assess as the damage caused thereby the stipulation will be upheld as liquidated damages; but where the object is to secure its performance by the imposition of an amount in excess of the loss likely to be sustained it will be considered a penalty, and will not be enforced.

The distinction between liquidated damages and penalties attached to contracts for the breach of same is not always easily drawn. The following rules have been deduced from the decisions of the courts on that question, viz.:

Where the sum fixed as liquidated damages is manifestly above the injury sustained it will be held to be a penalty, and only actual damage can be recovered.

Where the contract is for a matter of uncertain value, and a sum is fixed to be paid on the breach of it, the sum is recoverable as liquidated damages.

Where the payment of the money appears to have been intended only to secure the performance of the contract it will be construed as a penalty.

Where a contract contains a number of conditions, and the penalty is applied to only one of them, it is not recoverable as liquidated damages.

Forfeitures are abhorred, especially in courts of equity, and will not be enforced. The object of the courts is to make the parties whole, and where that is accomplished the ends of justice have been met. Hence it is difficult, in any case, to recover upon a breach of the contract more than the parties have been actually damaged.

It is frequently the case—indeed, it may be stated that it is generally so—that security is required of a contractor for the faithful peformance of the work. The general rules of law relating to suretyship appertain to cases arising under building contracts. Where a surety guarantees that the builder will execute his contract to the satisfaction of the employer, and the contract is materially altered without the surety's consent, he will be discharged, whether the change or variation in the contact is prejudicial to him or not. The reason is that a new contract has been entered into without his consent. The same thing is true if the time of performance is increased without his consent.

Where, by a contract, the surety guarantees the performance of the building agreement, which was to be paid for in installments, and the owner paid the installments before they were due, it was held that this act discharged the surety. So also, where the owner failed to insure the property, as agreed. So also where he made larger advances to the builder than contracted for.

It may be stated, as a general rule, that the surety is discharged whenever the owner and the builder change, in any respects, the terms of the contract. It is, therefore, important that the contract should always be strictly followed and observed, and an architect or engineer should be scrupulously exact in his construction of contracts and in the enforcement of their execution, because, as the agent of the owner, he may, by some act on his part, discharge the surety and thus materially damage his principal.

Of course many intricate questions must necessarily arise which it would be impossible for an architect or engineer to decide. Even the application of old and well-settled principles becomes frequently very difficult. In such cases the best advice I can give you is that you should advise your clients to apply to another worthy class of professional men for advice, viz., the lawyers.

In conclusion, I beg to add a few words upon the character of your professions, and the necessity of promoting and maintaining a high standard of education and ethics. The arts of architecture and engineering have been associated with some of the noblest achievements of the human race. In both we find the evidences of man's progress from a savage condition to a high state of civilization and culture. Like the other arts, architecture did not spring into existence at an early period of man's history. The idea of symmetry and proportion, which were afterwards embodied in material structures, could not be evolved until at least a moderate degree of civilization had been attained, while the efforts of primitive man in the construction of dwellings must have been at first determined solely by his physical wants. Only after these had been provided for, and materials amassed on which his imagination might exercise itself, would he begin to plan and erect structures possessing not only utility but also grandeur and beauty.

It is only by a thorough study of the history and the techniques of their arts that the architect and engineer can achieve rank and distinction, or even such knowledge and skill as will enable them to perform successfully the ordinary calls that are made upon them. Thorough training is not only important to the architect himself, but to the public as well.

No less important than knowledge and skill is a high standard of morals. Every profession ought to have an ethical code of a high order for its government. I doubt not that with you it is so.

Automatic Coal Weighing Machines for Power Stations.

[By Mr. Francis H. Richards, in *Cassier's Magazine.*]

Probably the progress made in no other art more accurately times the onward march of civilization than the art, or business, of handling crude materials. With every reduction, for instance, in the cost of handling earth, more than a proportionate amount of earth filling is made commercially profitable. The cost of handling ores and fuels, from the mines to the consumer, constitutes one of the larger items of their total cost at the place of use; and in whatever trade it may be, each handling of materials, every delay and incidental loss, is carried forward and ultimately appears in the charge against the consumer.

In power stations the problem of economical operation is not altogether the attainment simply of economy, but its maintenance as well. It is, indeed, hardly too much to say that the latter branch of the question is the more difficult of solution. In making a boiler test, for example, not only is the environment usually modified, but the cost of the test itself is, generally speaking, entirely excluded. In regular work, however, all charges and conditions, and all changes of conditions, are represented in the result. We have, therefore, to ascertain not only what work may be done, but what is actually done day after day.

The late Hon. Eckley B. Coxe, who strongly advocated the substitution of a continuous record of actual performance for the prevailing system of occasional tests, once stated the matter very tersely, saying:

"I am not so much interested in knowing what some expert may be able to do with my boilers, so as to know what work my firemen are actually getting from them every day."

To know this, however, means the measuring of the intake and the output—means accounting for the entire supply and production, so that the necessary comparisons may be made for formulating the result. In a power plant this, besides the accounting for cost of plant and attendance, involves the measurement of the materials used, of the fuel, ashes and water. This, again, involves an increase of labor and supervision, and, therefore, of cost, or the adoption of means whereby the measurements can be reliably and continuously made at a cost much less than the resulting gain. The automatic weighing machine supplies this requirement, automatically handling coal and water, much after the manner of an ordinary water meter, say, interposed in a water pipe, or a gas meter for that matter, giving a continuous and reliable record of what has passed through it.

In another way, too, may the automatic weighing machine serve a good purpose. Daniel Webster has been quoted for the way in which, in one of his speeches, he emphasized "the tremendous power of 6 per cent!" Certainly the investor of to-day looks sharply enough to the difference of 1 per cent. in the rate of interest chargeable against him. But does he look as closely to the other components of the "cost?" For instance, recent experiments indicate that the anthracite coal generally used for steam making will hold about 4 per cent. of water, without much dripping; and much of that coal is "watered" to this extent

before delivery. If, now, the coal pile be replenished twice a year with wet coal, it is evident that the buyer pays the interest rate plus 8 per cent. of the purchase price as the cost of the capital employed in "carrying" the fuel account.

Although the coal cannot, for obvious reasons, always be obtained dry, the drying may be readily effected in nearly all power stations before the coal reaches the bins by using heated air drawn from the upper part of the boiler rooms. Then, by weighing in through an automatic weigher and reweighing in the same way, first to the bins, and next directly to the furnaces, all of the required facts are obtained. The first weighings, by showing the amounts taken in and delivered to the bins, indicate the evaporation, and a comparison of the records of the second and third readings will show, at any time, the amount held in storage in each bin, besides giving the amount chargeable to each set of boilers.

In order to fully realize in practice the advantages obtainable from the use of the automatic weigher as a record maker, the weigher must not only be efficient and reliable in itself, but it must, like other machines, be properly installed. Engineers, accustomed as they are to make ample provision for even the minor accessory devices of furnaces and boilers, should not give less consideration to the weighing machines through which the real performance of the plant is to be known—to the machinery which, when once installed, becomes not merely an adjunctive apparatus, but a principal member of the system itself—the one member, in fact, on which the management must rely for any accurate knowledge of the extent to which economy of operation is maintained.

While the space required by the weighers is not large, it must be properly located. In some cases this will necessitate slight modifications in conveyers, or, perhaps, in the plans of the building. In no case yet observed, however, would the necessary provisions, if made in the original plans, have materially enhanced the cost. A common error is to place the upper run of the main conveyer or make the outlets of the bins so low that the conduits to and from the weigher cannot be set above the angle of repose of the coal, notwithstanding the fact that there may be ample room above. Proper care in these respects will avoid using additional conveyers or other special devices, and greatly simplify the management of the apparatus.

The advance of the art of power production appears to have reached a point where the general adoption of the automatic weighing machine has become a necessity. The capacity of the plant, and its possible ratio of economy are determinable by the facilities already in use. But the changing relations of owners and operators, increase of direct and indirect competition, and the resulting changes in methods of management, clearly demand the development of the boiler test into a continuous self-recording operation.

Gauge Making.

In a particularly interesting lecture delivered to the engineering classes at the Leland Stanford Junior University, Mr. J. Richards gave an account of some of the difficulties he met with in endeavoring to establish in America a factory for the production of standard gauges. When foreman in the works of the Ohio Tool Company in 1862 Mr. Richards constructed a set of shop gauges consisting of a stepped cone of cast iron. The steps varied from 3 inches to $\frac{1}{4}$ inch in diameter. The only standard used in constructing this tool was a short length of shaft, turned accurately to a 2-inch Whitworth gauge. The steps were cut with a finely tempered square tool, having its edge set parallel to the work. The 2-inch step was then turned or scraped to the exact diameter with this tool, which was afterwards fed forward the required amount for the other steps by giving the corresponding rotation to the feed screw, which a measurement previously made had shown to be fairly accurate. The gauges thus prepared were, of course, not strictly correct, but were much superior to the former absence in the works of any standard at all. The need for fixed caliper gauges was soon felt, and Mr. Richards had these made out of lune-shaped pieces of steel by Messrs. Brown, Sharp & Co., the arrangement being patented in 1867. Soon after Mr. Richards endeavored to start a factory for the production of accurate gauges on a large scale, but business difficulties hindered the work till 1877, when a commencement was made. Unexpected difficulties of a mechanical nature were, however, immediately encountered. In the first place, the Whitworth screws of the measuring machine, guaranteed accurate by the makers, proved unreliable, the pitch varying even in as short a length as 7 inches. This difficulty was turned by measuring the errors of the screws and making the proper allowances. A difficulty of a more serious nature arose, however, when an attempt was made to produce caliper gauges with parallel faces, by grinding, owing to the springing of the face of the grinding wheel under the pressure of the gauge, giving rise to curved surfaces. This trouble was got over by a method of grinding without pressure, invented by J. Morton Poole, Sr., of Wilmington, who prepared wheels with a fine grade of corundum, which, during the grinding, were flooded with a solvent of the cementing material. The results obtained with such wheels were remarkable. If a file, for instance, was carefully balanced on a pivot, and then one end of it brought against the wheel, instead of being repelled, the file seemed to be sucked up into contact with the abrasive surface, and could be ground away without any extraneous pressure whatever. Mr. Richards stated that no special skill is required in the workmen employed in gauge-making, as they soon learn to work as easily to $\frac{1}{10000}$ inch as an ordinary fitter does to $\frac{1}{100}$ inch. In grinding calipers, 25 may be taken at a time, and after a few passes in the grinding machine one is removed and another inserted until a close limit of accuracy is attained. The whole are then tested with the standard, and the errors recorded on them on chalk. Those in which these errors are less than $\frac{1}{2000}$ inch are then classed apart and the rest returned to the grinding room for correction. By repeated trials a second class is formed true within $\frac{1}{10000}$ inch, and though a third class true to $\frac{1}{25000}$ inch was also produced, such tools did not prove profitable to make, even though listed at a much higher price than the second class above referred to.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following letter explains itself:

PROVIDENCE, R. I., July 30, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: In two of your recent issues you refer to Mr. Garret A. Hobart, of New Jersey, Republican candidate for the Vice-Presidency, as being "a gas man." (See Vol. LXIV., No. 26, p. 1050; Vol. LXV., No. 1, p. 14.) In this connection it may also be of interest to note that Mr. Mark A. Hanna, Chairman of the Republican National Committee, probably also had some connection with gas interests, as seems to be shown by the early history of the American Gas Light Association. In the "Souvenir History" of that Association (published in 1895), at bottom of page 75, referring to the meeting held at Cleveland, O., May 13, 1874, it is said: "In the afternoon of the second day the exercises were closed with an excursion, starting at 3 P.M., on the steamer 'Havana,' upon the invitation of Mr. M. A. Hanna." The connection here noted is on the ground that this refers to the same Mr. Hanna, which I have no means of verifying, though he would seem to be the same man.

AT the annual meeting of the Ashland (Pa.) Gas Light Company the officers chosen were: Directors, John B. Price, Wm. A. Marr, Frank Rentz, George Morgan, Adam Waldner, Chas. C. Graeber, Jno. X. Dence, F. E. Heinze and Hunter F. Bright; President and Superintendent, John B. Price; Vice-President, Adam Waldner; Secretary, John X. Dence; Treasurer, Frank Rentz.

AT a recent special meeting of the Directors of the Altoona (Pa.) Gas Company, Mr. Joseph A. Ritchie was elected Treasurer of the Company, vice Mr. W. D. Couch, who resigned last spring because the insurance business in which he has been engaged for some time had grown to such proportions that it required all his time and attention for its proper management. Mr. Couch had acceptably served the Company as Treasurer for something over 20 years.

THE following is the record of the appeal of those concerned in the latest "strike" at the Montreal Gas Company; and it is to be hoped that the authorities will deal with it as it deserves—that is, to reject it with promptness and decision:

"To the Chairman and Members of the Light Committee of the City of Montreal—Gentlemen: The conditions of the supply of gas in this city being such as to create general dissatisfaction among the consumers, I beg to submit a proposal which I believe will effectually solve this question in the interests of the citizens. The contract of the 15th November, 1895, with the Montreal Gas Company, confers a practically perpetual right on this Company to supply gas at $1.20 per 1,000 cubic feet, to the exclusion of any competitive Company. Clause 3 says: 'During the existence of the present contract with the said Montreal Gas Company, the said city of Montreal shall not permit the laying of gas pipes in the streets and lanes of the said city of Montreal.' This

clause, however, does not prevent the city from owning gas works and laying its own mains, and I am advised by counsel that these are inalienable rights under its charter. Having regard to these circumstances I respectfully beg to make the following proposal:

"1. I, Henry Sampson King, hereafter called the contractor, will erect complete gas works on a site to be provided by the city, including 110 miles of mains, all service pipes, and 10,000 meters, the fixed and distributing apparatus and productive capacity of the works to be not less than 600,000,000 cubic feet per annum.

"2. The contractor will guarantee that the illuminating value of the gas shall not be less than 21-candle power, the gas to be produced from coal and oil, and that the cost in the consumers' meter shall not exceed 50 cents per 1,000 cubic feet, exclusive of 20 cents per mile for interest sinking fund on $1,750,000 of 4 per cent. city bonds, redeemable in 40 years, provided always that in respect of these guarantees the sale of gas by the municipality shall not be less than 1,000,000 cubic feet per day, and that the works shall be operated under the sole management of the contractor or his representative during the period of guarantee.

"3. The city shall procure all easements, licenses and legislative powers required for said works.

"4. The contractor shall have the right to sub-let or assign the whole or any part of the contract, and the city will concur in any such agreement or assignment.

"5. The total amount to be paid to the contractor for the complete works shall be $1,750,000, with 10 per cent. added if by working overtime the works shall be ready to supply gas within two years from the date of the site being placed in his possession by the city.

"6. Payment—The city will pay the contractor or his assigns 75 per cent. of the value of materials supplied or work done within 14 days of the presentation of their engineer's certificate, the payment to be in 4 per cent. municipal bonds, issued at par.

"7. Retention—The city shall retain the remaining 25 per cent for 12 months after the work shall be ready to supply gas, and at the expiration of 12 months the contractor shall be entitled to receive the said balance with 4 per cent. added provided always that the guarantees have been fulfilled, or remitted, as stipulated under clause 2.

"8. The contractor shall within one month of signing the contract deposit $50,000 with the City Treasurer, or find sureties in that amount for the due carrying out of his part of the agreement, this deposit to be returned or the sureties to be released so soon as an equivalent amount of work shall have been done or materials be delivered.

"9. At the expiration of the first 12 months of the supply of gas the city shall have the power to require the contractor, by three months' previous notice in writing, to operate the works for a further term of five years, the contractor providing all materials, labor and everything necessary for producing gas, which shall be of an illuminating power of not less than 21 candle power, for which the city will pay him at the rate of 40 cents for every 1,000 cubic feet delivered into the gasholders. At the termination of this period of five years the city can again require the contractor to operate the works for a further term of five years under the same terms and conditions.

"This would constitute the leading principle upon which I would suggest that an argument and contract could be based which would protect the citizens from the lasting oppression of an excessively high gas rate, and place the city in possession of a gas works with every modern improvement and a system of mains which will be free from the heavy percentage of leakage which must sooner or later compel the renewal of the present mains.

"I shall be pleased to submit any further information you may deem necessary, either personally or by letter, and trusting that you will have the kindness to give this matter your early consideration, I remain, gentlemen, your obedient servant, H. S. KING. Windsor Hotel, July 29, 1896."

THE Council, on the motion of Ald. Prefontaine, having had the petition read, referred the whole matter to the City Attorney, who was instructed to render an opinion as to whether or not the city had any rights in the premises, keeping in view the contract which existed between the city and the Montreal Gas Company.

"OBSERVER" forwards the following clipping from the Providence (R. I.) *Telegram*, of July 31st: "A short time ago the lighting companies of Bristol and Warren, R. I., formed a consolidation by uniting the gas and electric companies of the two towns under the name of the Bristol County Gas and Electric Company. The new company, it was understood, was to manufacture gas and electricity at a cheaper rate than the companies of the two towns could do separately, as it would be all done under one plant. The consolidated companies, it was stated, would locate in Bristol in the future, thus giving to the town considerable taxable property, as the plant would have to be of considerable size to furnish light for the towns of the county. The Council has not granted the petition of the Company to lay pipes, although Col. S. B. Colt, who represented the Company, submitted concessions the Company would make. The matter has been very quiet for several weeks until yesterday, when the consumers of gas in Bristol received the following notice from the Gas Light Company with much surprise:

"*To Our Customers*: It is with regret that we find ourselves compelled to notify you of an advance in the price of gas from $2.50 to $3.50 per 1,000 feet, to go into effect August 1, 1896. The necessity for this advance is owing to the fact that with the limited quantity of gas now consumed in town we have found it impossible to meet expenses the past six months, to say nothing of earning a dividend upon our capital stock. We had hoped that by joining with adjacent towns in the use of gas to so increase our consumption and reduce our expenses as to enable us to decrease instead of increasing the price to our patrons, but in this—although we had gone to large expense in the purchase of piping—we have been blocked by the Bristol Town Council, who have declined to permit us to lay our pipes, purchased nearly a year ago. By order of the Board of Directors, J. HOWARD MANCHESTER, Secretary."

THE Waltham (Mass.) Company's regular semi-annual dividend of 3 per cent. is payable on demand.

GAS INSPECTOR KRECKE says, in his annual report respecting the operations of the Detroit city gas and gas meter inspecting department, for the year ended June 30, 1896, that the gas supplied by the Detroit Gas Company was in every sense up to the requirements of the statutes. On the complaint of consumers, 202 gas meters were tested, of which 78 were found to be fast—average error, 4.02 per cent.; and 30 were found to be slow—average error, 6.24 per cent.

ATTORNEY THEODORE M. BATES, representing the Cleveland (Ohio) Gas Light and Coke Company, recently had a conference with County Solicitor Kaiser relative to the abatement of the tax on some of the Company's property, the sum sought to be recovered amounting to $6,000. Mr. Bates says that the main pipes are listed as real estate, and that when the decennial board, in 1890, raised the valuation of the real estate in the city, it raised the valuation of the pipes, which, he declares, ought to be listed as personal property.

MESSRS. A. L. REED, H. C. REW and associates have applied to the City Council of Omaha, Neb., for a franchise for an opposition gas works for that place. The projectors ask for a 40-year franchise, with the stipulation that the price of street lamps shall not exceed $20 per lamp per annum, and that the price of gas supplied to private consumers shall not exceed $1 per 1,000 cubic feet.

SUPT. A. H. PARKER, of the Bangor (Me.) Gas Light Company, is completing extensive main additions, in response to demands for a gas supply from residents in districts heretofore outside that Company's main system.

AT the annual election of the Fall River (Mass.) Company, the following result was reached: Directors, John S. Brayton, Oliver S. Hawes, Geo. P. Brown, Samuel T. Bodine, Randal Morgan, Walton Clark and Lewis Lillie; President, John S. Brayton; Clerk and Manager, George P. Brown; Treasurer, Edward C. Lee; Superintendent, Joseph E. Nute.

THE annual meeting of the other Fall River gas enterprise (the Manufacturers Gas Light Company) resulted in the election of the following officers: Directors, Charles M. Shove, James E. Eddy, Joseph A. Baker, David A. Brayton, Jr., F. H. Dwelly, C. M. Hathaway and F. W. Brightman; President, Charles M. Shove; Clerk and Treasurer, Joseph A. Baker.

THE following is from the Pittsburgh (Pa.) *Dispatch*, dated July 30: "Judge J. W. Simonton, of the Dauphin County Court, yesterday rendered an opinion denying the exclusive charter of the Consolidated Gas Company to supply gas to Pittsburgh, and declaring that the Pittsburgh Illuminating Gas Company possessed such an exclusive charter. The opinion was the result of *quo warranto* proceedings instituted by Attorney-General H. C. McCormick against the Pittsburgh Illuminating Gas Company. The latter was represented in the contest by Knox & Reed and Lyon, McKee & Anderson. Messrs. Lyman D. Gilbert

and Watson & McCleave were the counsel for the Consolidated Company. The opinion of Judge Simonton is the first decision on the constitutional right of the Legislature to revoke charters. It also sustains the legality of the Acts of 1895 relative to exclusive gas charters. The Pittsburgh Illuminating Gas Company was formed January, 1895, at a capitalization of $10,000,000, to supply illuminating gas in Pittsburgh. It applied for an exclusive charter under the Act of 1874, on February 18, 1895, claiming that no Company had previously accepted the privileges of that Act. The Consolidated Gas Company, which had been created in 1871 under a special Act, on February 15, 1895, accepted the Act of 1874. A sharp legal battle was then fought before Secretary of the Commonwealth Frank E. Reeder, between ex-Judge James H. Reed and Attorney J. F. Sanderson and Attorneys David T. Watson and Lyman D. Gilbert, the latter Deputy Attorney-General. The applicants for a charter claimed that the Consolidated Company had made no effort for 21 years to accept the exclusive privilege of the Act of 1874, and that it should not be granted an exclusive privilege, as it owned but 13 miles of pipe and supplied comparatively few consumers. The right of an old Company to accept the exclusive privileges was also questioned. Secretary Reeder finally granted the charter to the Pittsburgh Illuminating Company, with exclusive privileges. The Consolidated Company asked Attorney-General H. C. McCormick to institute proceedings in *quo warranto* against the Pittsburgh Company on the ground that the Consolidated Company had prior exclusive rights. The battle was fought before Judges Simonton and John J. McPherson, at Harrisburg, last May, ex-Judge Reed and Attorney Sanderson opposing Attorneys Watson and Gilbert. The defendant's counsel claimed that the exclusive privileges granted by the Act of 1874 applied only to new corporations created under it, and not old Companies. It was claimed that the purpose of the Act was to enable new Gas Companies to build up without competition, for under the words of the Act it was considered that when five dividends of 8 per cent. had been paid by a Company it would be strong enough to meet competition; and then it was that its exclusive privileges should cease. It was also argued that in 1895 the Legislature had passed two Acts, one annulling the exclusive charters held by Gas Companies created under special Acts, and the other amending the Act of 1874, to forbid the granting of exclusive charters to old Companies. The purpose of the exclusion Act was to build up new Companies, and it would be unfair and contrary to its purpose to grant established Companies such privileges. The constitutionality of the acts of 1895 was called into question. These were based on section 10, article 16, of the Constitution, and the opinion is the first decision on the power of the Legislature in that respect. Judge Simonton handed down his decision that the Consolidated Gas Company is not and was not on May 8th, when the Pittsburgh Illuminating Company was incorporated, invested with the exclusive privilege of manufacturing gas for light only within the city of Pittsburgh, and, therefore, in accordance with the stipulation filed by the parties, judgment is directed to be entered in favor of the defendant. After reciting the act of 1874, so far as it related to the case under consideration, Judge Simonton says: 'It is manifest from the terms of the act that it was the intention of the Legislature to revoke and annul the exclusive privileges which Companies incorporated prior to April 29, 1874, had acquired by accepting the provisions of the act of that date, and of the Constitution of 1874, and as the Consolidated Company was one of these, that the Legislature intended to revoke and annul its exclusive privileges. If, therefore, the Legislature had the constitutional right to revoke and annul these privileges, it certainly did so, and the sole question which remains is, 'Did it have such right?' After referring to the acts under which the Consolidated Gas Company gained exclusive privileges, Judge Simonton says: 'There has, therefore, been no moment of the corporate existence of the Consolidated Company in which it did not hold all its rights and privileges, including its right to exist, subject to the reserve right of the Legislature to alter the terms upon which it might exist, or to terminate its existence, whenever, in the opinion of the Legislature, its existence, or any of its rights, privileges or immunities claimed by it, where injurious to the citizens of the Commonwealth, subject only to the condition that the alteration or revocation of its charter should be made in such a manner that no injustice shall be done to the corporation or its successors.' Judge Simonton says the law contains no restriction upon the right to alter or repeal, but simply upon the manner in which the alteration or repeal is made, and adds: 'The common law principle was that when a corporation ceased to exist its title to property, which it owned at the time, also ceased, and that its real estate reverted to the original owners, and its personal property was forfeited to the State; and it was doubtless to avoid the effect of this principle that this condition was annexed to the right of appeal. After quoting Justices Field and Cooley in a noted case to sustain his position, Judge Simonton says: 'These illustrate the meaning and effect of the provision that the amendment or repeal of the charter shall be made in such manner as not to do injustice to the corporators. Property rights acquired by the corporation must be preserved for the use and benefit of the corporators, and a repeal must not take place in such manner as to leave them without proper remedies to ascertain and conserve their rights. * * * It is only in cases where a charter has been granted not subject to the reservation of the right to alter, revoke or repeal, that right is held to depend upon whether the corporation has given any consideration for the privileges.'"

THE Consolidated Company will appeal for a review and rehearing of Judge Simonton's decision before the Supreme Court.

ON July 31st the Cleveland (Ohio) Gas Light and Coke Company, and the Peoples Gas Company, of the same city, submitted a report of their respective gross receipts, for the half year ended the date mentioned, to the City Auditor, under the provisions of their charters, which specify that 6½ per cent. of such gross receipts shall be turned into the city treasury. From the returns made the city will receive $23,196.16 from the Cleveland Gas Light and Coke Company, and $5,108.68 from the Peoples Gas Company. The sums turned into the city treasury since the agreement became effective—the total from both Companies is meant: 1893, $42,113; 1894, $45,044.48; 1895, $50,445.96; 1896, $55,462.07—a total of $193,065.51. The fiscal year on which these sums are based ends on July 31st.

THE Directors of the Norwalk (Conn.) Gas Light Company have perfected the following executive organization: President and Treasurer, E. J. Hill; Vice-President, E. K. Lockwood; Secretary, Henry Chasmar.

GAS INSPECTOR MEEDS reports that during the month of July the gas supplied in Minneapolis was up to all the requirements of the ordinances governing the service. The candle power (average of 26 tests) was 25.13; the sulphur content averaged 18.95 grains per 100 cubic feet; the average pressure (maximum) was 2 inches; average minimum, 1.64 inches. Two meters were examined on complaint of consumers. One was condemned; the other was within the legal limit.

AT the annual meeting of the Chelsea (Mass.) Gas Light Company the officers elected were: Directors, Wm. G. Peck, George W. Moses, J. K. Montgomery, James Tent, Francis Low, Thomas Martin, Albert D. Bosson and Henry W. Hart; President, Wm. G. Peck; Treasurer, Geo. W. Moses; Clerk, Albert D. Bosson.

THE proprietors of the Santa Ana (Cal.) Gas and Electric Company made the following proposition to the authorities of that city under date of July 20th:

"The Santa Ana Gas and Electric Company hereby proposes and offers to furnish to the city of Santa Ana, for five years from this date, the use of its entire street lighting system, except the engine and boiler, in the said city, consisting of one 30-light 1,200-candle power dynamo, 30 lamps, 15 of which are now in use in the streets of said city, and all poles, wires, etc., now in use in said street lighting plant, upon the following conditions, to wit:

"1. The said plant is to be furnished for the consideration of one dollar.

"2. The city is to use and operate said dynamo in lighting the streets to the full capacity thereof.

"3. A correct and itemized account of the expenses of operating of said plant to be kept, and at the end of each month published by the city.

"4. The said plant is to be kept in good repair and returned in the same condition as when received, ordinary wear and deterioration being excepted.

"In witness whereof the said Santa Ana Gas and Electric Company has hereunto caused its corporate name to be subscribed and its corporate seal to be affixed on the date first above written by its President and its Secretary thereunto duly authorized by its Board of Directors, at their meeting held July 20th, 1896."

AT the annual meeting of the New Bedford (Mass.) Gas and Edison Light Company the following officers were elected: Directors, Gilbert Allen, Horatio Hathaway, Horace G. Howland, David B. Kempton, George F. Kingman, Thomas H. Knowles, John W. Macomber, Chas. W. Plummer, Chas. R. Price, George R. Stetson, Chas. H. Lawton, John P. Knowles, Jr., and Frederic Taber; Treasurer and Clerk, Charles R. Price.

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MONDAY, AUGUST 10, 1896.

A Model Power Plant.

By reason of the facility with which high pressures can be transmitted by hydraulic systems they are much used where powerful steady pressure is necessary. For hydraulic forging from 6,000 to 10,000 pounds per square inch are used, but much less in various presses, etc. The last hydraulic plant of note which has been installed was built by the Pope Tube Works, of Hartford, Conn. Outside of the bicycle tube drawing plant, for the operation of which it was installed, the power plant possesses considerable interest by reason of the facility with which all operations are conducted. The plant is run by steam under 135 pounds pressure from four 78-inch Leavitt return tubular boilers having a heating surface of 2,157 square feet each, which are set about 6 feet above the grate and have each 134 3-inch tubes. The engines are triple expansion, the condensed water being fed through a duplex pump with lagged steam cylinders and attached water meter from an oil separator and returned to the boilers; the drips from all parts are collected by pipes and pumped into the oil separator, thus saving all the oil used and insuring a minimum of scale. The fuel is buckwheat or pea coal, automatically charged into the iron coal bunkers, or into the automatically weighing hoppers over each set of boilers, by means of a conveyer. This conveyer also takes coal from the hoppers of the coal bunkers on its return trip and discharges it into the hoppers, or it receives ashes from the hopper bottomed ashpits of the boiler fireplace and dumps them into cars.

Regular feeding is assured by the Coxe automatic stoker and traveling grate, the coal from the hoppers being weighed automatically, dried as they pass around the smoke box of the boiler, and fed by the stoker upon the grate moving backward from the doors at the rate of 3 to 6 feet per hour; this grate is driven by the blast fan engine, whose speed is reduced by a very ingenious differential mechanism from 45 revolutions per minute to three fourths of a revolution of the grate sprocket driving shaft. Blast is furnished by a fan under ¾-inch pressure, with engine attached. This engine is regulated by the boiler steam pressure, the greater the pressure the less draft, until at the blow off point the fan stops entirely and the fires die down. One man is supposed to attend to four boilers.

All steam pipes are covered, and so arranged that contraction or expansion will cause no pressure on the boilers or pumps. The two Riedler pumps are duplicates, designed to furnish 1,100 gallons of water per minute to the draw benches under 1,200 pounds pressure, are triple expansion with condenser adjacent, and have a water-weighted accumulator each, with rams 12 inches diameter and 10 feet and 16 feet long. The accumulators also act as governors on the engine speed. The pump room is separated from the boilers by a brick wall, has a silicate cement floor similar to the boiler room, which supports also the electric plant for the works. A traveling crane attends to all heavy lifting and moving of parts in repairing. Both buildings are fireproof, well lighted, with stone foundations laid in cement mortar.

The Loss of Light by Frosted Globes.

The London *Journal* "notes" that some fresh determinations of the loss of light due to the employment of clear and frosted glass globes have been made by Mr. Stort, and are published in the "Electrotechnisches Zeitung." The lamps used in the experiments were 10 ampere arc regulators, fitted with carbons 17 mm. diameter for the positive, and 10 mm. for the negative. The naked light showed a maximum intensity of 1,161 candles; the mean spherical intensity being 362 candles. With clear glass globes there was an apparent loss of 6 per cent; and with frosted globes, of 11 per cent. The mean spherical illuminating power with the frosted globes was 320 candles. The effect of opal globes does not appear to have been measured, although these are in far more general use than frosted globes. Losses of light from this source of from 30 to 40 per cent. are admitted; and a good deal more may be lost through the accumulation of dust and soot upon street lanterns in towns. It is observed that no improvement in luminous efficiency seems to have been made in electric arc lamps during the past 15 years; the prevailing types being yet far from possessing the luminous value attributed to them in electricians' estimates.

The Market for Gas Securities.

There is not a market for anything just now, the news of to-day (Friday) in respect of quotations for gas shares being particularly depressing. Consolidated is reported at 135 to 136, with Equitable at 180 to 190, Mutual 200 to 220, New York and East River common, 23 to 28, and Standard common 72 to 75. These prices in no sense represent the real values of the shares, but under the prevailing conditions of distrust it is not unlikely that even lower figures are to be recorded. We can, and do say, however, that there is no actual cause for the depression in city gas shares; to the contrary, there is reason why they should sell higher now than they ever did before.

Brooklyn Union is quoted at the ridiculously low figures of 78 to 81, and Chicago gas sold to-day down to 45¼. Perhaps it would be as well to let the actual figures tell the story, as shown by the following quotations—for it is not safe to say anything of the course of the market at the present juncture.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

AUGUST 10.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	135½	136¼
Central	500,000	50	150	..
" Scrip	230,000	..	100	.
Equitable	4,000,000	100	180	190
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	200	220
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	23	28
Preferred	2,000,000	100	..	70
Bonds 1st 5's	3,500,000	1,000	95	97
" 1st Con. 5's	1,500,000	..	..	85
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	72	75
Preferred	5,000,000	100	97	100
Bonds, 1st Mortgage, 5's	1,500,000	1,000	108	111
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	78	81
" " Bonds (5's)	15,000,000	1,000	100	101
Bay State	5,000,000	50	16	17
" Income Bonds	2,000,000	1,000	30	32
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	75	80
2d " " "	3,000,000	1,000	60	62
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	46½	43⅝
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	..	78
" Bonds	600,000	1,000	97½	99
Cincinnati G. & C. Co.	7,000,000	100	196¾	197
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	58	59
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	80	90
" Bonds	2,000,000	..	..	93
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	..	130
" Bonds, 6's	2,650,000	..	100	102
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	..	92½
Bonds	1,000,000	1,000	85	90
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	17¼	18½
Preferred	2,500,000	100	70	80
Bonds	9,034,400	1,000	..	88¾
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
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Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	93¾	95
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	.
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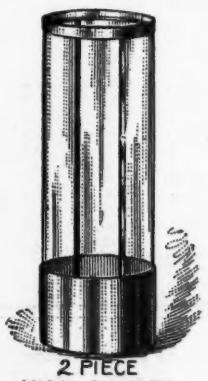

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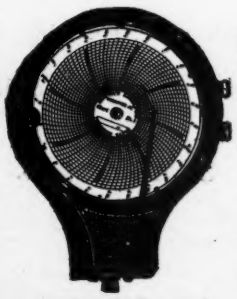

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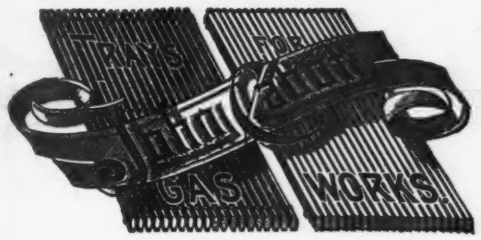

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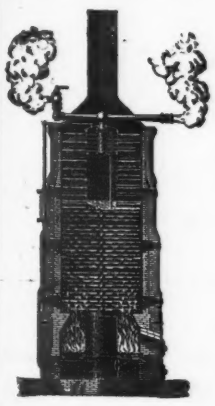

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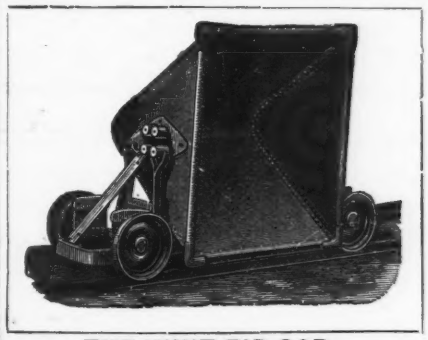

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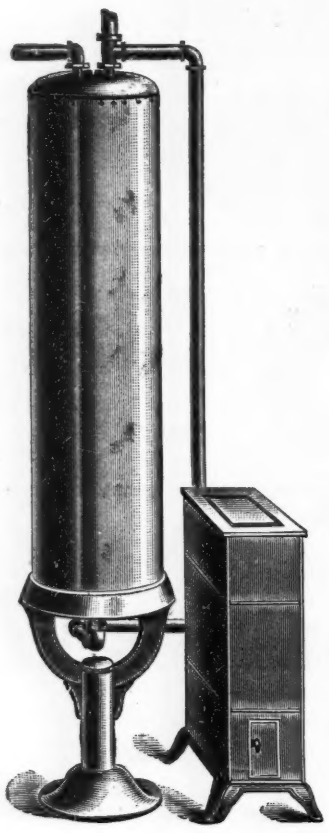

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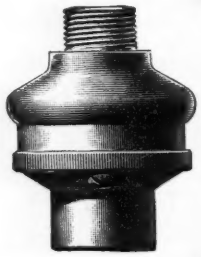

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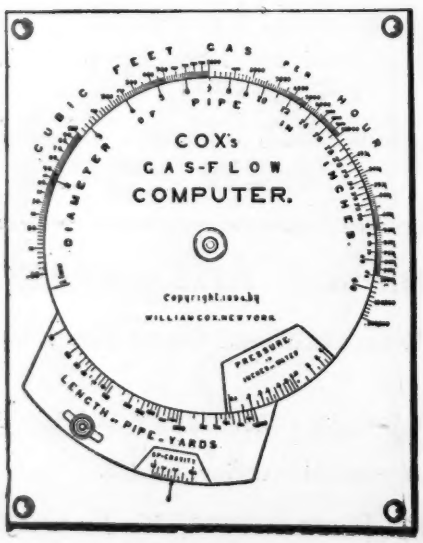

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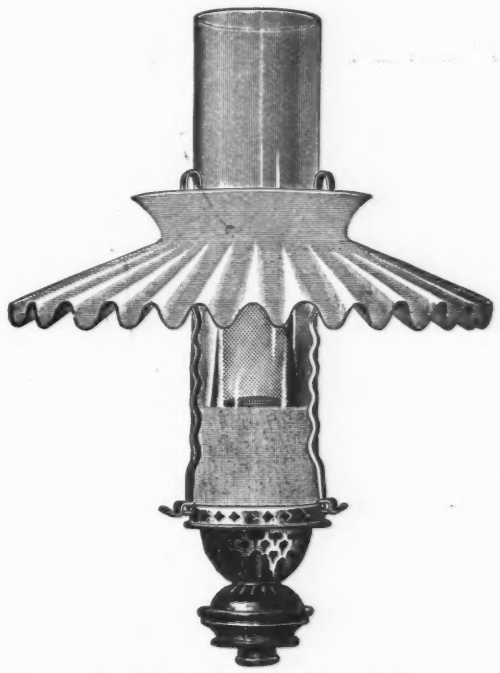

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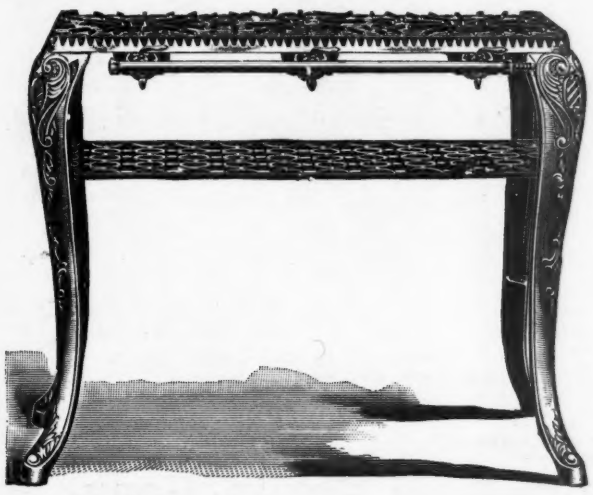

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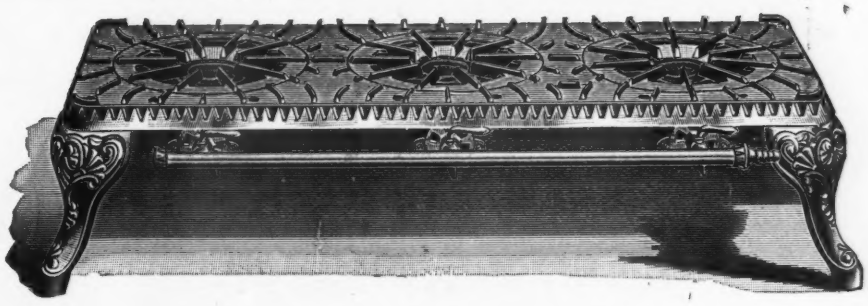

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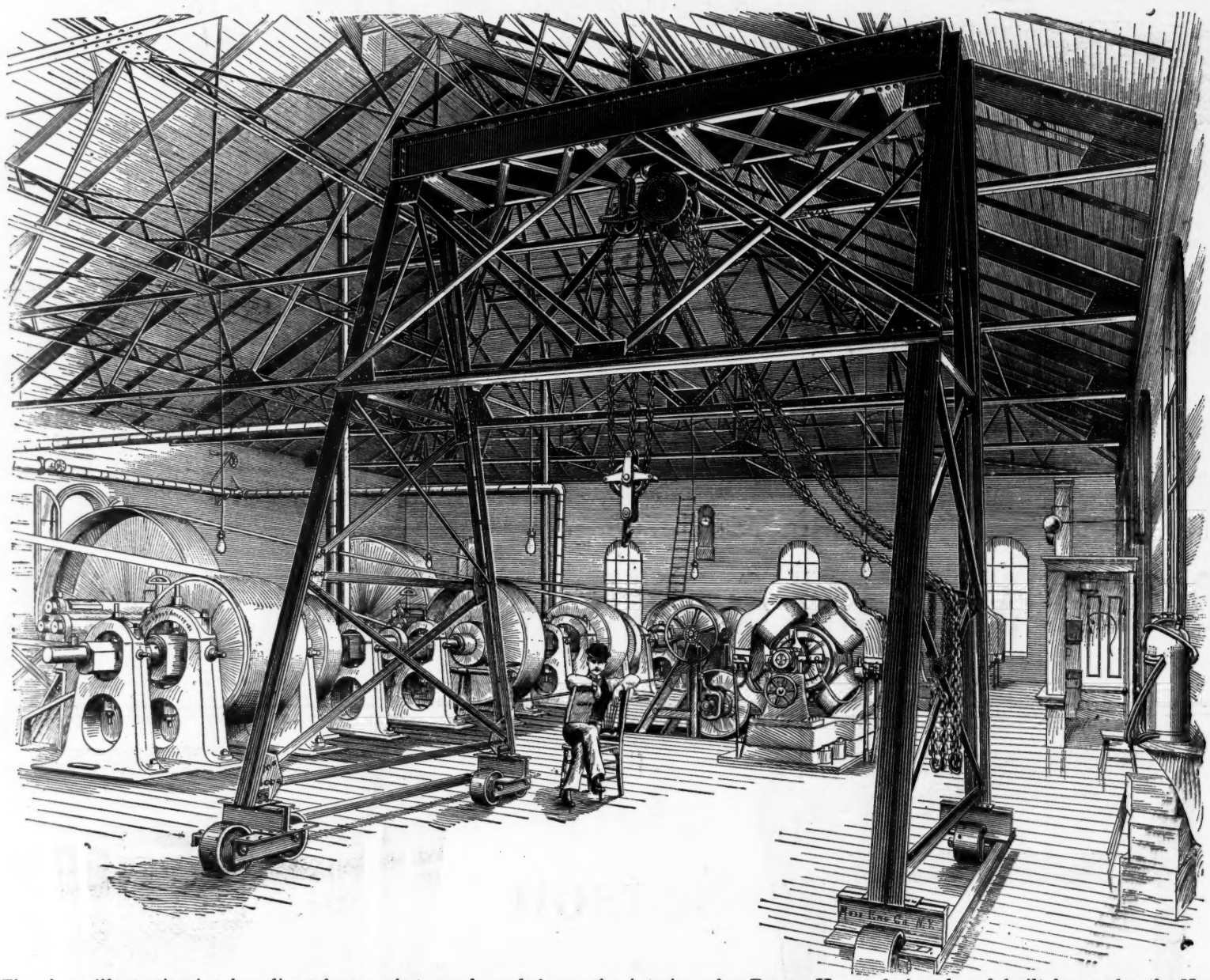

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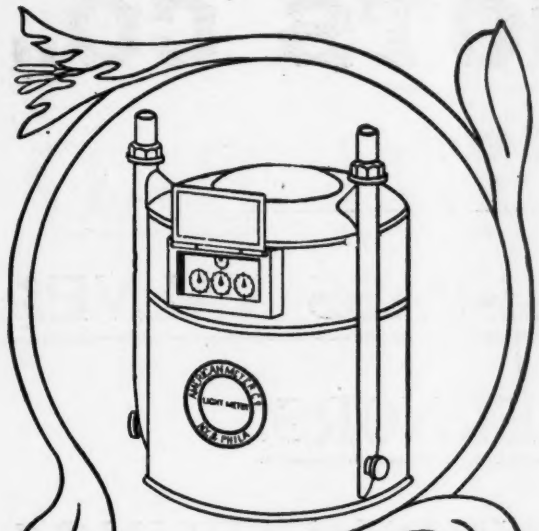

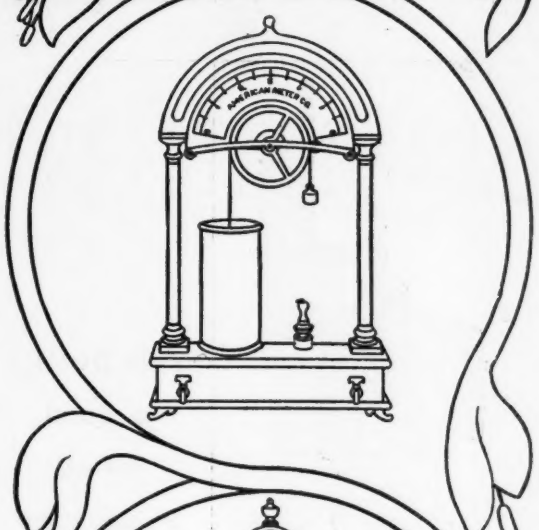

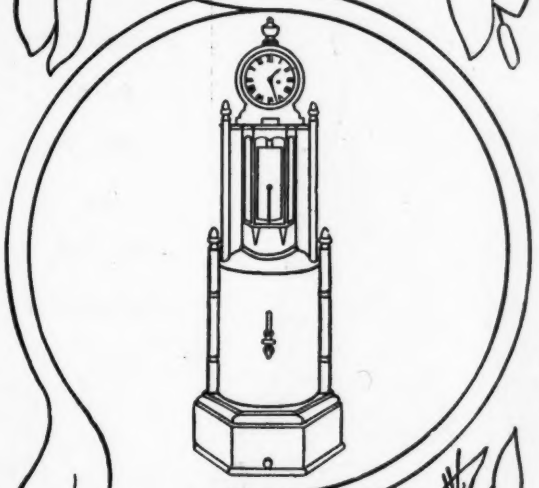

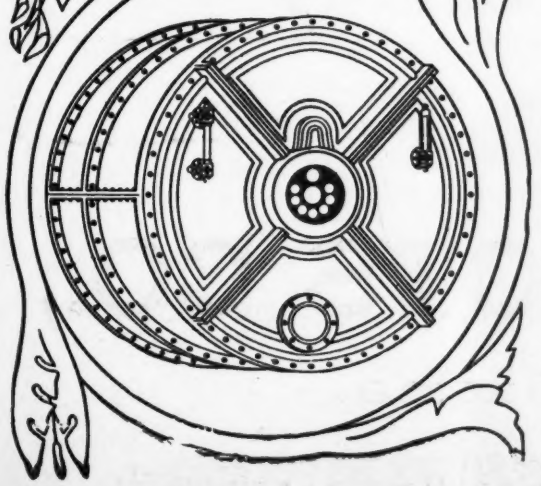

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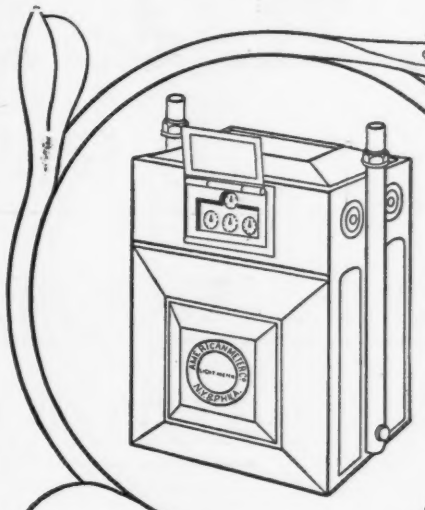
PUBLIC LIGHTING TABLE.

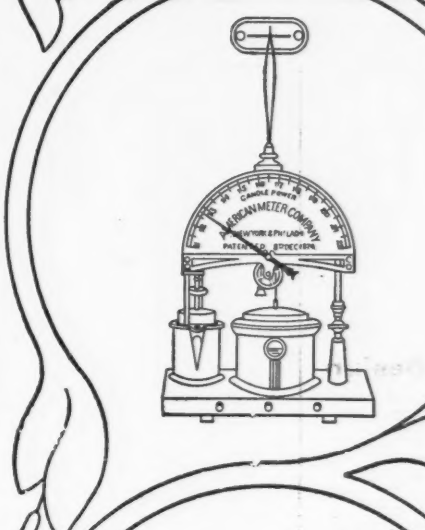
AUGUST, 1896.

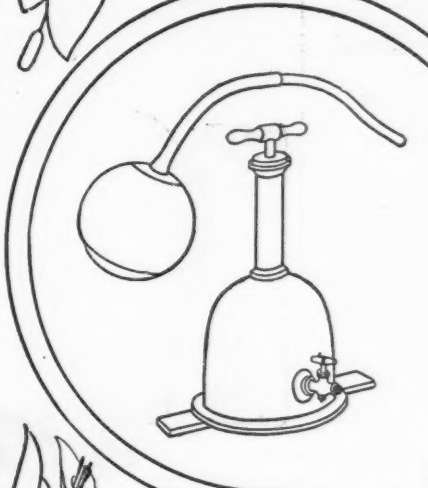
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sat.	1	7.50 PM LQ	11.40 PM	7.10	3.30
Sun.	2	7.40	12.10 AM	7.10	3.30
Mon.	3	7.40	12.50	7.10	3.30
Tue.	4	7.40	1.50	7.10	3.30
Wed.	5	7.40	4.00	7.10	3.30
Thu.	6	7.40	4.00	7.10	3.45
Fri.	7	7.40	4.00	7.10	3.45
Sat.	8	7.40 NM	4.00	7.10	3.45
Sun.	9	7.30	4.10	7.10	3.45
Mon.	10	7.30	4.10	7.10	3.45
Tue.	11	7.30	4.10	7.10	3.45
Wed.	12	7.30	4.10	7.10	3.45
Thu.	13	8.10	4.10	6.55	4.00
Fri.	14	8.40	4.10	6.55	4.00
Sat.	15	9.20 FQ	4.10	6.55	4.00
Sun.	16	10.10	4.20	6.55	4.00
Mon.	17	11.00	4.20	6.55	4.00
Tue.	18	12.10 AM	4.20	6.55	4.00
Wed.	19	1.10	4.20	6.55	4.00
Thu.	20	2.20	4.20	6.45	4.10
Fri.	21	No L.	No L	6.45	4.10
Sat.	22	No L. FM	No L.	6.45	4.10
Sun.	23	No L.	No L.	6.45	4.10
Mon.	24	7.10 PM	8.10 PM	6.45	4.10
Tue.	25	7.10	8.30	6.45	4.10
Wed.	26	7.10	8.50	6.45	4.10
Thu.	27	7.10	9.20	6.30	4.20
Fri.	28	7.10	9.40	6.30	4.20
Sat.	29	7.10	10.10	6.30	4.20
Sun.	30	7.00 LQ	10.50	6.30	4.20
Mon.	31	7.00	11.30	6.30	4.20

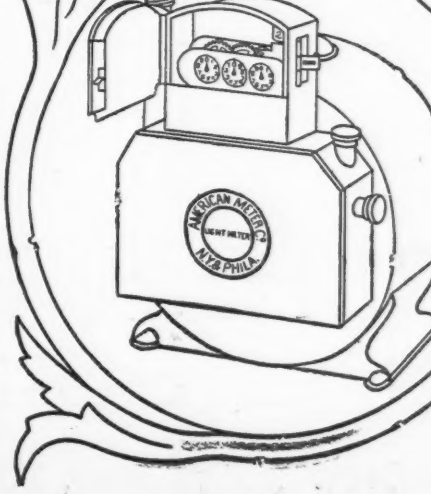
TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00









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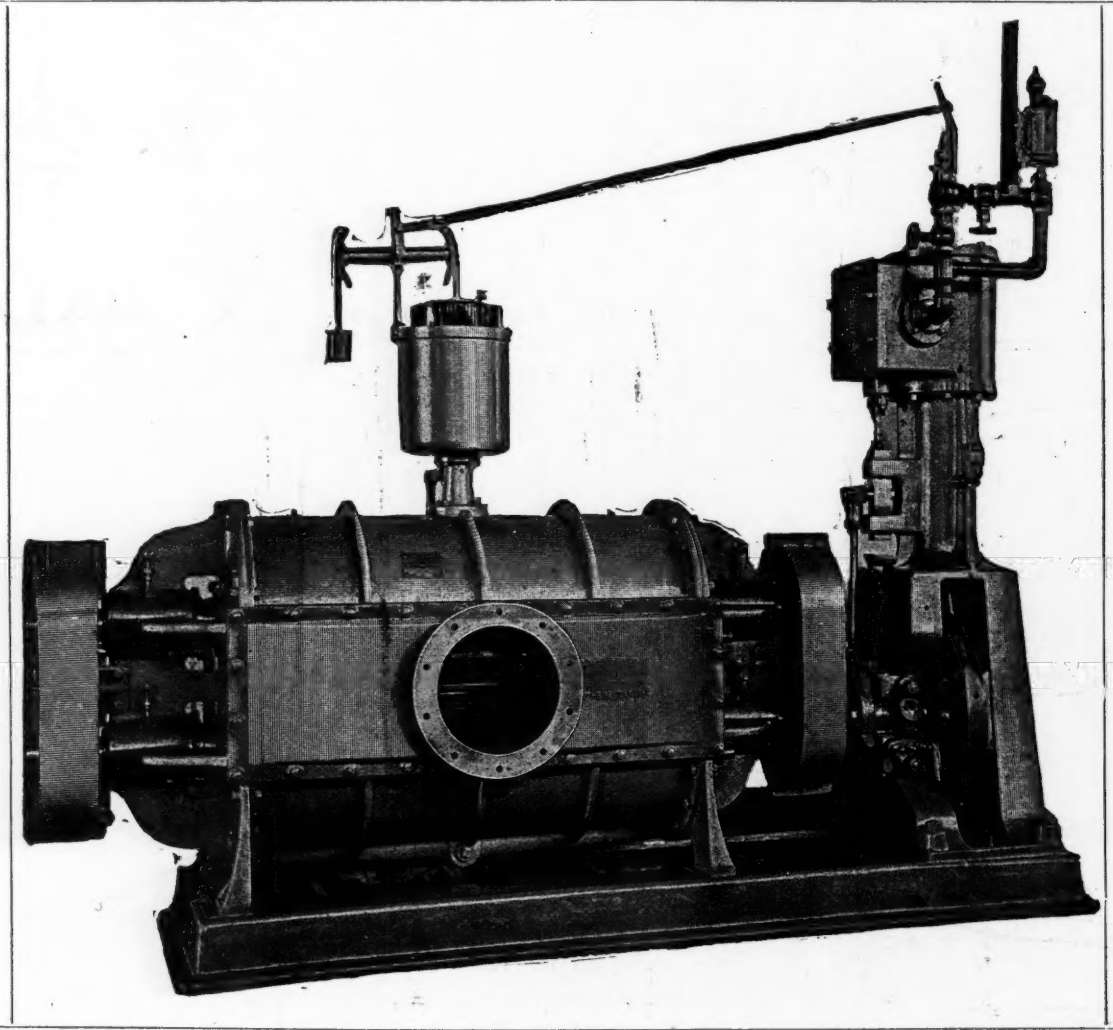

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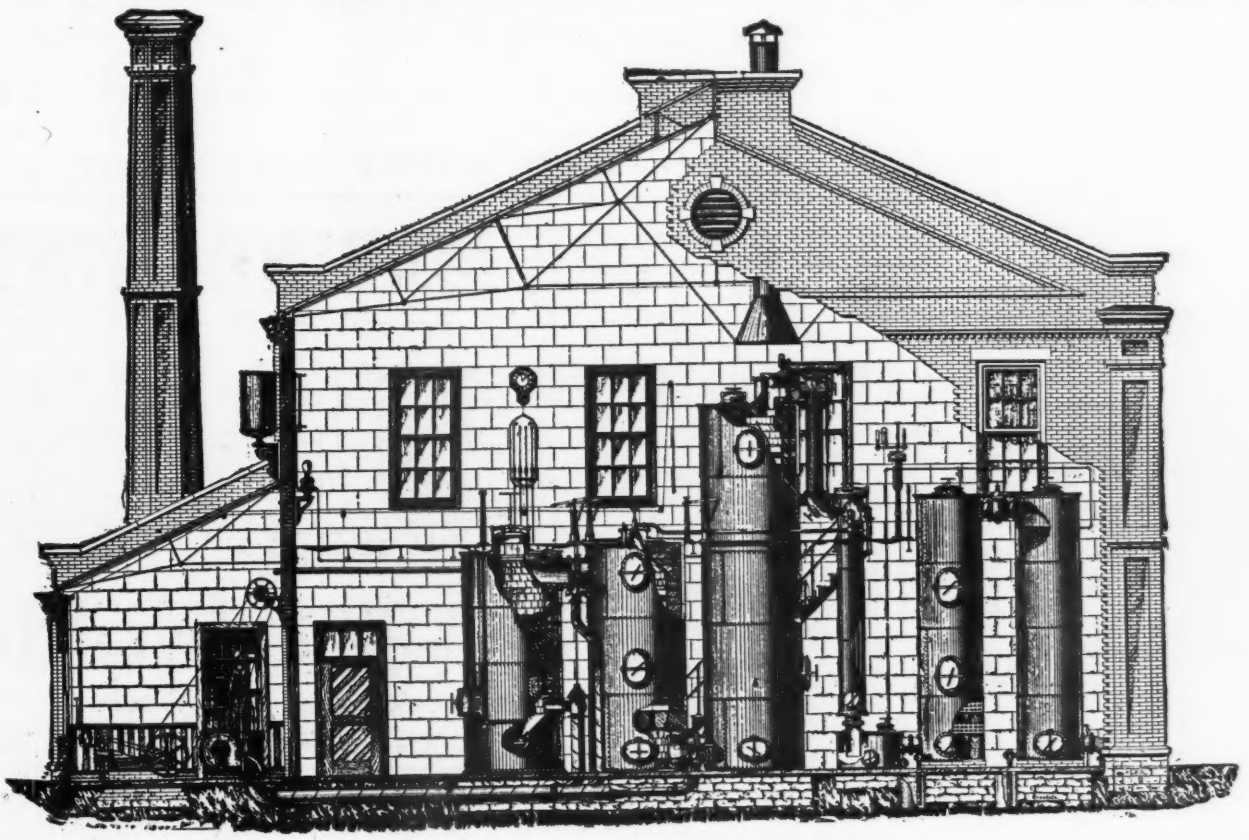

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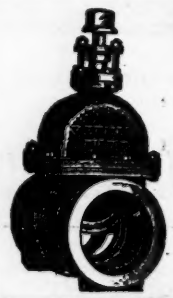

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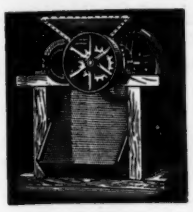

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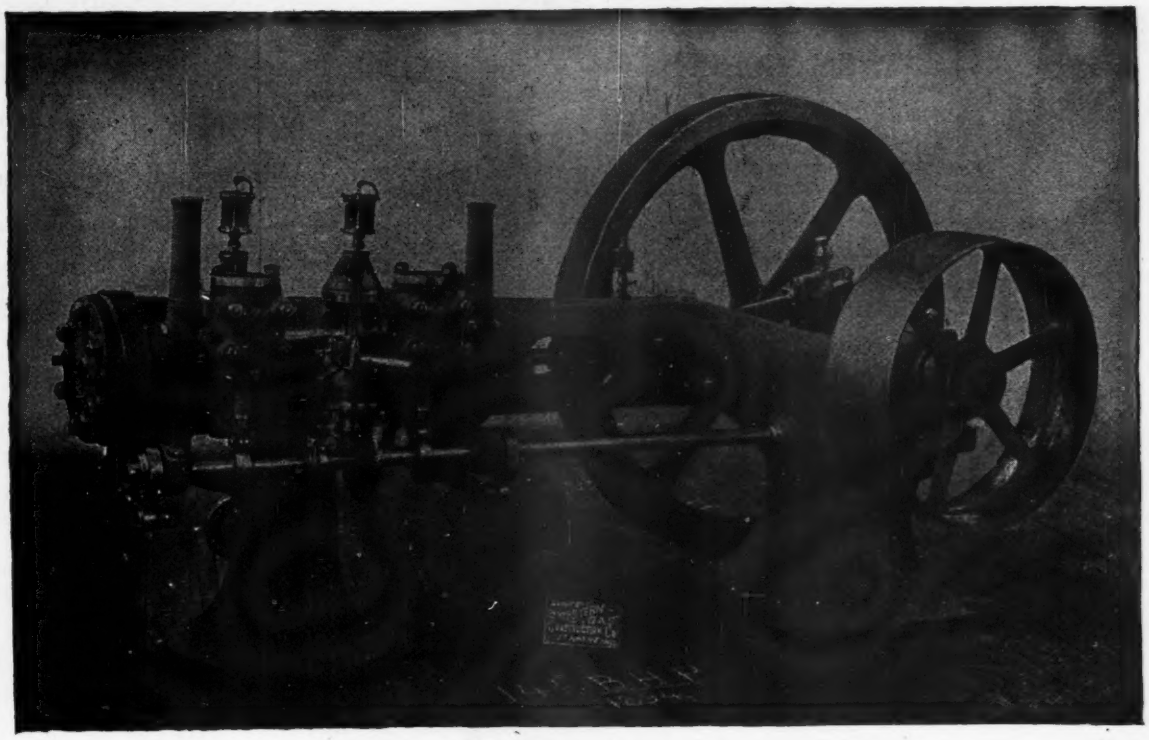

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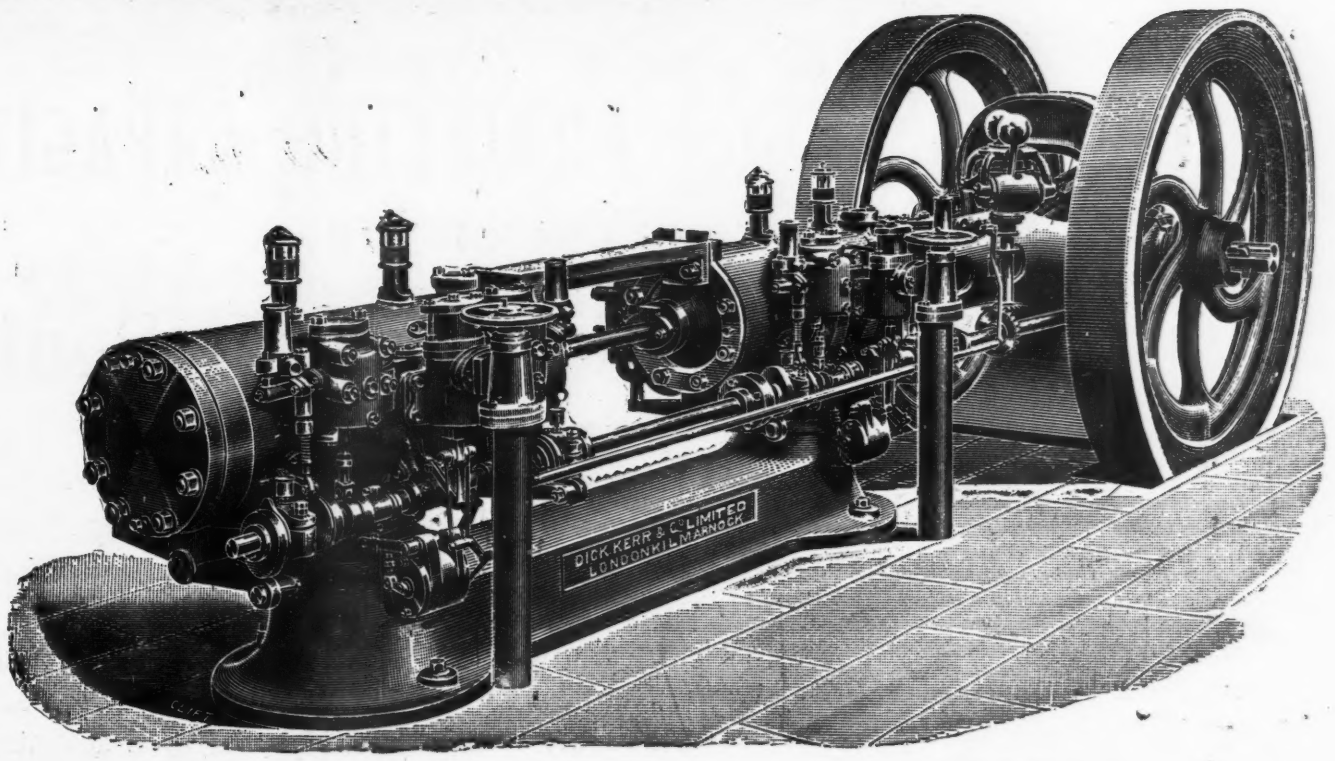

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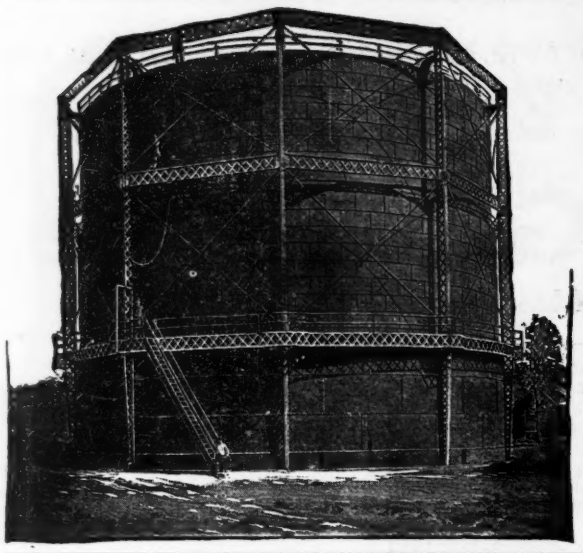

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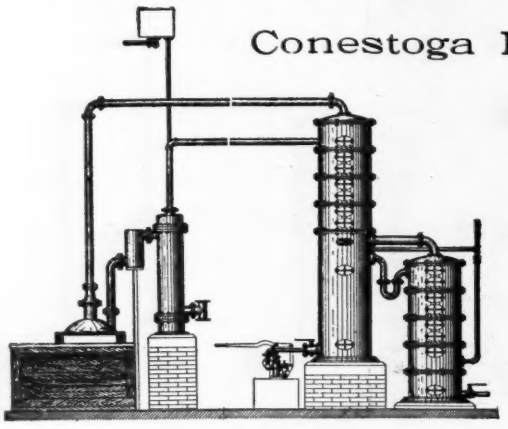

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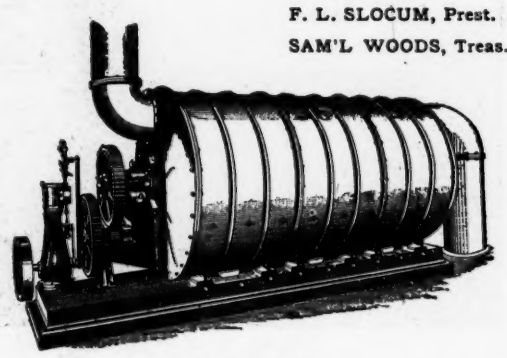

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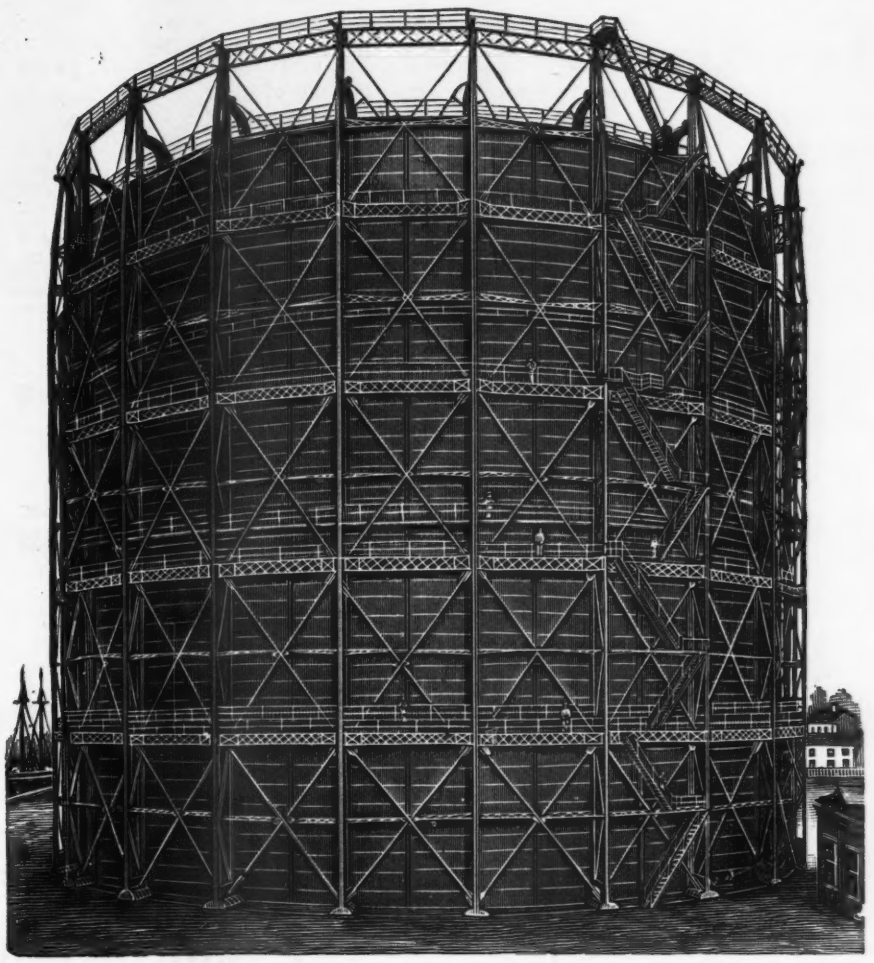

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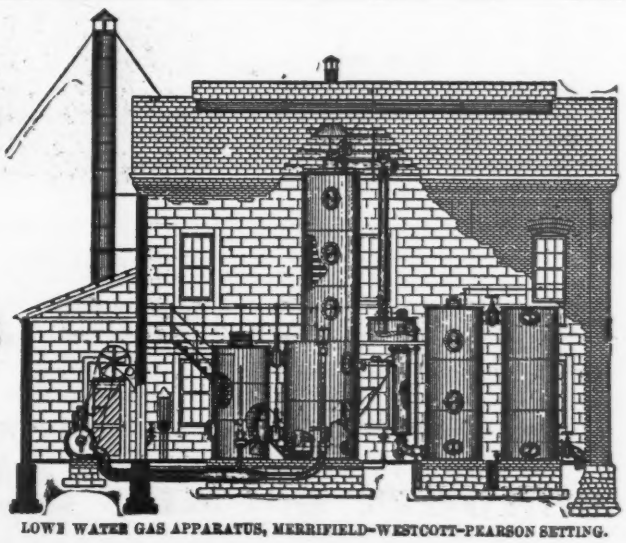

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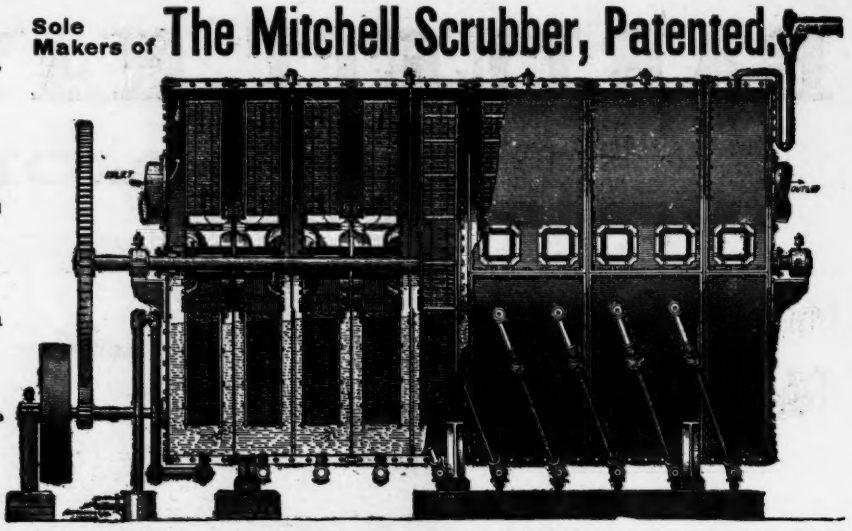

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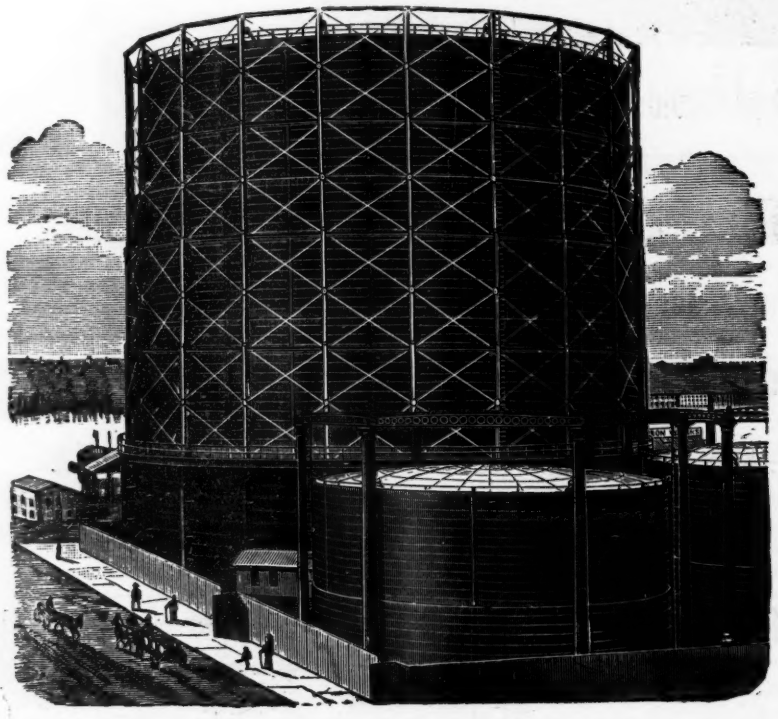

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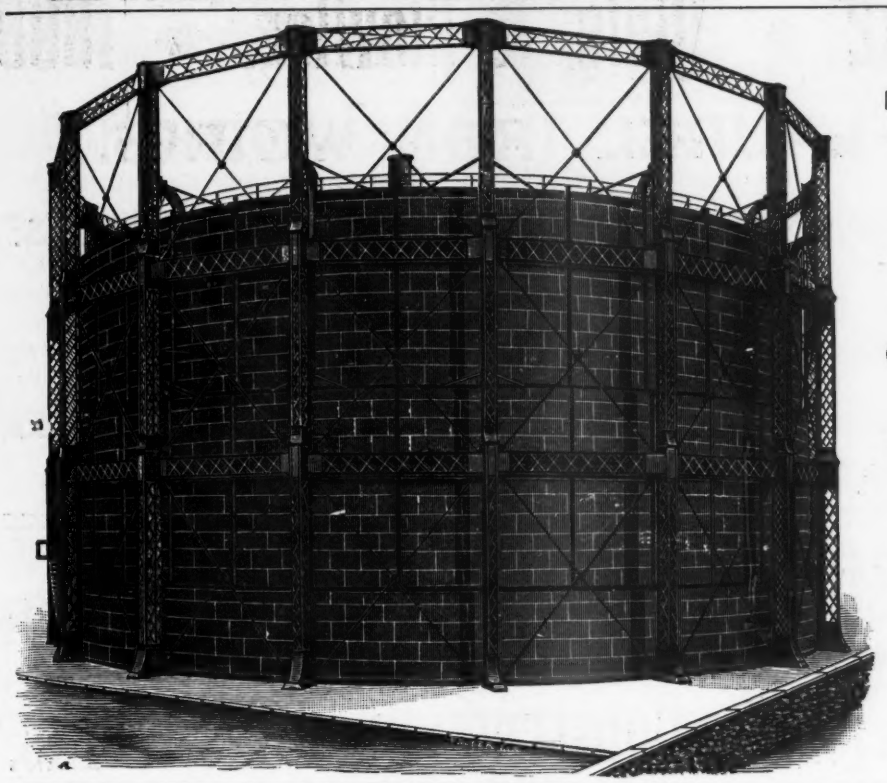

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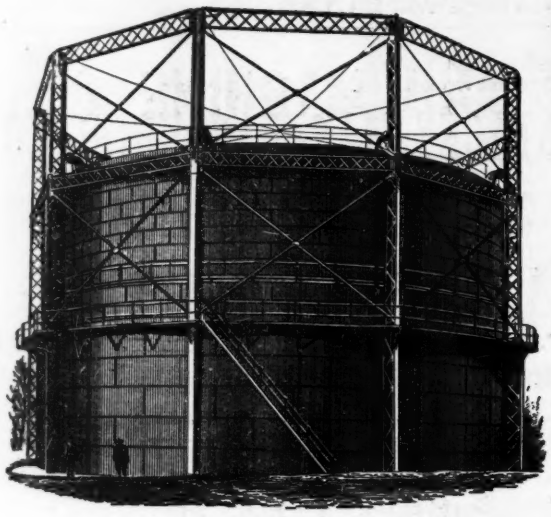

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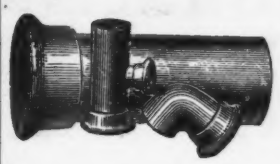

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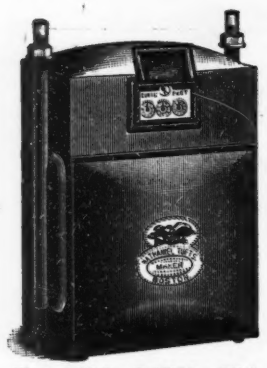

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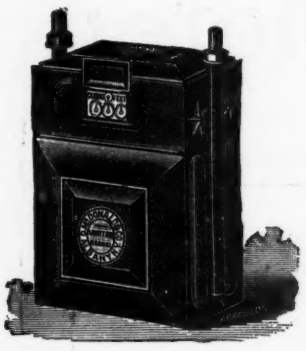

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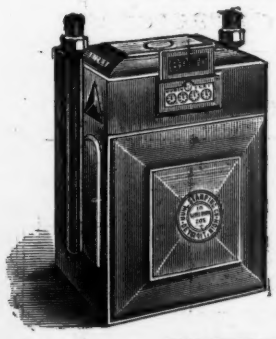

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